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Contents

Editorial

MEDICAL STUDENTS AND MILITARY TRAINING

NEARLY all medical students are between the ages of twenty-one and thirty-five years—the draft age. It was thought when the draft started that medical students would be exempted until they had graduated and had one year of intern training. Then it was discovered that this was for the most part wishful thinking. At the present time if a quota must be filled in a locality, medical students can and will be drafted. This would turn out to be a costly mistake.

No group of men are more anxious to do their bit for their country than the members of the medical profession. In time of war the health of the fighting forces and the civilian population will depend on them. Not only must one look to the present but look also far ahead; for who knows when the present emergency will terminate? A doctor of medicine cannot be made by any known short cut.

To draft medical students would be akin to killing the goose that lays the golden egg. Cut down on the embryo physicians and the day will come when an acute shortage will be felt. This would be calamitous. Every year a percentage of the members of the profession die or retire because of age or infirmities. This loss is met by our medical colleges graduating fresh medicos annually.

Each medical college is geared to take care of a certain number of students. For example, some colleges can handle fifty students in each class, others a hundred. This calls for a certain amount of equipped laboratory space and clinical material for teaching purposes. By a slow process, a teaching staff is assembled—an evolution of years—and that staff is usually sufficient to meet the teaching requirements of the number of students making up the classes of a particular college. Suddenly to cut down or attempt to enlarge present day classes would raise havoc. A great loss in a student body would put a tremendous financial burden on an institution; few places are geared to accept suddenly extra large classes anticipating that the number of students subsequently might be lessened by the draft.

With those, only a few of the problems in mind, the Deans of Medical Colleges have tried to meet the situation. Their aim is to co-operate with the government officials. They want to prepare the way so that any number of trained doctors of medicine can be called if and when needed. In every manner these far-seeing and professionally trained men—the deans—are anxious to keep their schools going efficiently. They also desire to graduate their quota of well trained young men, as well as to regulate the profession so that at all times there will be sufficient professional men for the army and navy, for public health and for the needs of the civilian population.

We are informed that they have been conferring with the proper officials in the Nation's capital.

We hope these government officials will be willing to co-operate with the Deans of our medical schools. We pray all concerned will discover a common formula by which the production of physicians will go on uninterruptedly, and at the same time trained doctors of medicine in sufficient numbers will be available for all the requirements of the country.

Since the foregoing was written the following editorial appeared in the N. Y. World-Telegram on March 17, 1941:

MEDICAL STUDENTS AND THE DRAFT

A bill introduced by Senator Murray of Montana would amend the draft law so that medical and dental students, hospital internes and resident hospital physicians would not be conscripted until they have completed their professional training.

Arguments for it are that these young men will be more useful, whether in military service or in civilian life, if permitted to finish their training now and that the internes and resident doctors are greatly needed in the hospitals, many of which already are understaffed.

The argument against it is that if draft deferment is granted to one class of men it will be demanded for other classes.

If any class has a better blanket claim to deferment than all others we'd say it is the medical and dental students and hospital workers. So we think the Murray bill should at least have thorough consideration by Congress.

One thing is certain: The draft law as it stands, with its insistence that each local draft board shall be free to consider each man's case on its individual merits, is producing many unfair complications. Some local boards, for instance, defer all medical students and internes. Other local boards have different policies. This lack of uniformity runs all through the draft system, the local boards not being required to follow standard rules as to deferment for married men, skilled workers, students or members of any other group.

Action by Congress apparently will be necessary to put more uniformity into the draft system, and that action should come soon.

Such a proposed bill should be given serious consideration. We agree with the writer in concluding, "Action by Congress apparently will be necessary to put more uniformity into the draft system, and that action should come soon."

Medical students are exempt in Canada and Canada is at war. We hope common sense and not hysteria will be the rule in our country.

T. S. W.

Original Articles

THE DIAGNOSIS AND TREATMENT OF ACUTE DISEASES OF THE ABDOMEN IN CHILDREN

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INTRODUCTION

THE acute surgical diseases encountered in childhood differ from the common acute conditions from which adults suffer. Not only do children suffer from different types of ailments, but the same illnesses may not manifest themselves in the same manner as in adults, and the treatment required may vary. For these reasons, the surgeon who deals with young individuals should possess a basic knowledge of pediatrics. Sympathy, tact, patience, firmness and gentleness are primary considerations in the management of the ill child. Too often a hasty, superficial examination is made because the patient is not old enough to make himself understood and is frightened and unco-operative. Attempting to make a diagnosis in children is often a difficult and tedious process. When a history is obtainable, it should be as thorough as possible. Details derived from relatives must be sifted carefully, since in their anxiety for the patient their statements are apt to be misleading. If thoughtfulness and delicacy are employed, a complete, informative examination can usually be made. Keen observation and intelligent reasoning must be utilized while conducting the investigation, for the few signs and symptoms exhibited by the child may be the only evidence upon which a diagnosis can be based. It can readily be seen that close co-operation between the family physician or the pediatrician and the surgeon is essential.

GENERAL CONSIDERATIONS

There are many fundamental differences between acute diseases of the abdomen in children and in adults. These differences are both psychological and physical. Ordinarily no effort is made by the child to obscure the history. The mind of the child is not confused with the fear of a possible operation or the sympathy to be gained by such a procedure. But the nervous system is not as stable in children as in adults and their reactions to psychic stimuli are more marked. While positive statements are essentially truthful, negative statements cannot be relied upon.

Physical signs in children must be elicited with great gentleness and keen judgment is required for their evaluation. It should be remembered that the muscular and fat layers are not so thick and that there are relatively different anatomical relationships. Distention and tenderness are easily recognized but difficulty may be experienced in localizing the latter. Care and patience are required in order to distinguish voluntary resistance and true rigidity. It has been shown that children are less resistant to infection because the peritoneum is not so well vaccinated by auto-infection, lymphatic absorption is more rapid and the omentum is poorly developed.

Experience has demonstrated that a rather definite relationship exists between the age of the child and the acute abdominal lesion from which he is suffering. Persistent vomiting during the first few weeks

of life suggests the presence of congenital hypertrophy of the musculature of the pyloric ring. Intussusception is common in infants between six and twenty-four months of age. Acute appendicitis, one of the most common lesions in persons of all ages, is rare before the age of one year. The greatest incidence of pneumococcic peritonitis seems to be between the fourth and the tenth years. Peculiarly enough the sex of the child also has been found to be of some significance in diagnosis. For example, congenital hypertrophy of the pyloric muscle and intussusception are more common in boys, while pneumococcic peritonitis occurs more frequently in girls.

When a child is apparently suffering from an acute abdominal disease, it is essential to establish whether the pathologic condition is truly abdominal in origin, and if it is, whether prompt surgical intervention is required, or whether the symptoms are referred to the abdomen from some other part of the body. Occasionally, acute tonsillitis is accompanied by abdominal pain as well as by fever and vomiting. These signs and symptoms, when sufficiently prominent, may be disconcerting. In an adult, lobar pneumonia will rarely be mistaken for intra-abdominal disease, but in children differentiation becomes more and more difficult the younger the infant. Diaphragmatic pleurisy is not easy to distinguish from peritoneal irritation, especially in young individuals. While both of the latter conditions give rise to referred abdominal pain and even rigidity, the local tenderness and rigidity associated with peritonitis is usually more marked and definite.

Typical cases of pyelitis are not difficult to differentiate from intra-abdominal disease, but in many instances atypical manifestations are exhibited. These are apt to add to the confusion if the two conditions occur together. Moreover, it is common to encounter patients suffering from acute appendicitis who have revealed all the signs and symptoms of pyelitis. Acute lesions of the spine or hip also may produce evidence

suggestive of abdominal disease but usually these conditions can be identified by physical and roentgenologic examinations.

On the other hand, there is a common medical condition, arising in the abdomen, which is apt to be perplexing when an attempt is being made to determine whether surgical treatment is necessary. During an epidemic of this disease, namely, "enteritis," "enterocolitis," or so-called "abdominal influenza," or "intestinal flu," any abdominal complaint is likely to be labeled with one of these terms until further developments make such a diagnosis untenable. All of these facts emphasize the importance of a thorough examination before arriving at definite conclusions. Too many children have died from overwhelming peritonitis following perforation of a gangrenous appendix because a diagnosis of "intestinal flu" was made after hasty and superficial examination.

After having determined that the acute disease is confined to the abdomen, an untiring attempt should be made to determine the exact character of the pathologic condition. In general, most acute abdominal lesions in children can be placed in one of two classes, namely, obstructive or inflammatory. Intermittent, colicky pain is suggestive of distention of a hollow viscus, such as the small or large intestine, appendix, kidney or ureter. Ordinarily this pain is referred by specific nerves to a definite somatic segment, the location of which offers a clue to the site of the real disease. On the other hand, sharp, constant pain is more apt to be due to irritation of the parietal peritoneum. Such irritation produces local pain and usually is situated over the site of the diseased organ. When obstruction is present, tenderness and rigidity are absent. It is only when the tissues have become devitalized that tenderness and involuntary rigidity are detected near the site of the lesion. However, if the abdominal disease is inflammatory in origin, localized tenderness is soon followed by true rigidity of the abdominal muscles.

EXAMINATION OF CHILDREN

If fine distinctions are to be made and the best results obtained, a different technic should be employed when examining children, because of their more delicate tissues, their reaction to physical and psychic stimuli and their emotional imbalance. In order to obtain co-operation, the confidence of the child must be gained and a definite effort made to minimize the disagreeableness of the procedure. The suspected site of the disease should not be touched until the end of the abdominal examination; for if the child is hurt at the start, it will be difficult to obtain a true comparison with other areas. After gently inspecting more distant parts, the hand is laid over the diseased organ. Skin tenderness, muscle spasm, deep tenderness, and finally, rebound tenderness, are tested in order. The whole procedure is performed while looking and talking to the child. This not only permits the physician to gain the child's confidence and to distract his mind but often mild degrees of tenderness can be detected by watching the patient's facial expression and body movements.

Rectal examination should never be neglected, especially when attempting to locate abdominal disease. Because of the small size of the child's anus the well anointed and gradually introduced examining finger, supplemented by gentle pressure on the abdomen from above, has ready access to all pelvic structures. If the exploration is done slowly and gently, little objection will be raised.

As most children have had previous experience with examinations of the ears, nose, throat, and chest and are usually upset by them, these measures are left to the end. The necessity for these investigations, even though the primary pathologic condition has been discovered in other parts of the body, cannot be emphasized too strongly. If there is still some question as to the diagnosis, roentgen films are often of indispensable value.

Disproportionate extremes in temperature, pulse rate and respiratory rate are often encountered in acute conditions in children. Usually the temperature in itself is of little assistance in diagnosis. The pulse rate is a more reliable guide but often may be little affected during the early stage of disease. Nevertheless, great variations from the usual relationship of temperature, pulse and respiration are important. When this occurs, the condition is more apt to require medical rather than surgical attention. A short period of observation will often do much to clarify the situation.

Stool examinations are even more important in diagnosis in children than in adults. Their frequency, gross characteristics, the presence of blood or mucus, and the presence or absence of bile, as well as the detection of various bacteria or parasites, are frequently the clues required for forming an accurate opinion. Small, ribbon-like stools may be due to a congenital stricture of the anus. In the infant, failure of meconium to appear suggests the presence of stenosis or atresia of the intestine. Most inflammatory lesions in the abdomen in children are associated with constipation, but there are exceptions. Blood in the stool of children may be discovered in a variety of conditions such as epistaxis, Meckel's diverticulum, intussusception, rectal polyp, enterocolitis or purpura hemorrhagica. The amount of blood present, its color, clotting characteristics, and admixture with mucus and fecal material must all be considered in making a diagnosis.

Repeated urinalyses and complete blood counts and erythrocyte sedimentation rates are essential parts of the examination. The presence or absence of albumen, sugar, blood, pus, casts and bile in the urine may be informative. Acute lesions of the renal tract are notorious for trapping the unwary and unsuspecting physician. However, it should always be remembered that pus and even blood in the urine are not diagnostic of a primary renal lesion; for both of these findings may be discovered in cases of acute appendicitis, particularly when the in-

flamed organ lies along the ureter or beside the bladder. The characteristics of both the red and white blood corpuscles are instructive in certain forms of anemia and in blood dyscrasias. The white blood cell count values should be considered as collaborative evidence, but they are never diagnostic in themselves.

DIAGNOSIS

As mentioned previously, the acute abdominal lesions from which children suffer usually differ remarkably from those observed in adults. While acute appendicitis is the most common condition found in both stages of life, intussusception and intestinal obstruction are more frequently experienced during childhood. Hypertrophy of the pyloric muscle, while ordinarily not considered an abdominal emergency, is an acute condition frequently encountered in children which requires rather prompt treatment. Fortunately, the field of acute abdominal disease in childhood is relatively narrow. Certain conditions, such as gastric or duodenal ulceration and malignant neoplasms, are extremely rare in early life. Acute salpingitis, which is seen so frequently in the adult female might also be considered in the same category as these latter ailments, but it is surprising at what an early age pelvic inflammatory disease may make its appearance.

When all available information is at hand, the history should receive special consideration. The character of the onset of the illness is important and may be diagnostic, as in cases of intussusception. The relationship between the time of onset and the development of the physical signs should be carefully estimated. If the child has been vomiting and has had abdominal pain for several days and physical examination reveals little evidence of distention or rigidity, the condition is not likely to require surgical intervention. A history of persistent pain followed by nausea or vomiting and associated with a rising pulse rate and diminished peristalsis should direct attention to the necessity for surgical

treatment. On the other hand, when the nausea and vomiting precede the pain and the other symptoms just described, and when diarrhea is present, the patient is more apt to need medical therapy, unless intussusception is present. The diagnosis is made by fitting together the pattern formed by the history, symptoms, physical signs and laboratory aids. Then after weighing each fact in the balance of experience and judgment the nature of the disease is determined and appropriate treatment is instituted. Needless to say, no one is infallible in diagnosis, particularly in children. It is always well to remember, however, that delay in performing operation in the hope of making a complete diagnosis may have serious consequences.

ACUTE APPENDICITIS

Statistics reveal that the appendix is responsible for the great majority of acute abdominal conditions, since 90 per cent of the cases of acute abdominal disease in children under ten years of age and 75 per cent of the cases in adults are due to acute appendicitis. There is no age limit to appendicitis, several cases having been recorded in babies forty-eight hours old. However, the incidence of the disease increases with age, reaching a peak in the second decade of life.

Acute appendicitis in children is notorious for the rapidity with which the disease progresses. There is evidence to show that acute appendicitis is not at all times the same condition.[1] When appendicitis is coincident with, or immediately subsequent to, upper respiratory or other acute infections, the inflammation is usually hematogenous in origin and usually due to the streptococcus. In these instances, there is usually an explosive acute suppurative process present involving the entire wall with extensive areas of necrosis and hemorrhage. Early perforation, followed by generalized peritonitis, is the rule. This type of the disease is ushered in with symptoms of unusual severity. As a rule the attack is the first of its kind. These observations might

explain the occurrence of epidemics of acute appendicitis, particularly in the autumn and winter months. If the lumen of the appendix is obstructed by fecaliths, kinks, adhesions or foreign bodies, gangrene and perforation may occur early in the course of the disease because the blood supply to a portion of the organ has been interrupted and infarction occurs. Occasionally, the initial symptoms may not be marked, but may be initiated by attacks of colic-like pain. In contrast with streptococcic infection, the pathological process progresses rather slowly when injury to the mucosa results in invasion of the appendix by organisms of the colon bacillus type. If perforation does occur in such cases, there is a tendency for a localized abscess to develop rather than spreading peritonitis. Such a patient usually presents those signs and symptoms which one ordinarily associates with the textbook descriptions of appendicitis and he often gives a history of similar attacks.

A. DIAGNOSIS

The establishment of the diagnosis of appendicitis in children is usually more difficult than it is in adults because of the inability to obtain an accurate history and the lack of full co-operation on the part of the patient. The classical signs and symptoms of the disease, such as generalized abdominal pain, nausea or vomiting, the shifting of the pain to the right lower quadrant in four to six hours, the rise in temperature, leukocytosis, and localized tenderness and rigidity, scarcely need to be reiterated. Appendicitis manifests itself in much the same way in children, but one has to depend more on the cardinal symptom of pain and the fundamental sign of localized tenderness. If all children suffering from appendicitis conformed to the pattern just described, the diagnosis would not be difficult. But in many instances the clinical picture is distinctly atypical. There may be few or no anterior abdominal signs, little pain, slight nausea, no vomiting, a high or low temperature, and varying

degrees of leukocytosis or even leukopenia. Tenderness will usually vary with the location of the appendix. It may be encountered under the liver when the cecum has not descended and arouse suspicion of hepatic or diaphragmatic inflammation. When the appendix is retrocecal, the pain and tenderness may be elicited in the region of the right kidney, suggesting pyelitis or other renal pathology. The presence of blood in the urine adds to the confusion. If the inflamed organ lies low in the pelvis, the pain will be felt centrally. There is often dysuria, resulting from irritation of the bladder, or an ineffectual diarrhea originating from sigmoidal or rectal involvement. Perhaps the most disconcerting finding is that in which the pain occurs only in the left side of the abdomen. This is sometimes due to a retroperitoneal appendix or to one attached to a long mesentery which extends across the midline. In a few instances the pain is referred to the left side without adequate explanation.

B. DIFFERENTIAL DIAGNOSIS

Regardless of how careful the investigation may be or how thorough the examination, mistakes in diagnosis are sometimes inevitable. No one is justified in criticizing a surgeon for removing a normal appendix, if the symptoms were suggestive of appendicitis and the diagnosis, although incorrect, was made within the time limits of safety. In view of the tragic consequences which might result from prolonged delay, particularly if there has been a history of catharsis, early operation is imperative. Bastianelli[2] explained the situation very aptly by stating: "When physicians are discussing whether a case is appendicitis or not, it is; when they are inclined to admit the possibility of appendicitis without being sure of it, it not only is, but is already perforated with more or less circumscribed peritonitis."

The condition which is most frequently mistaken for acute appendicitis is acute mesenteric lymphadenitis following upper respiratory infection. The infective or-

ganisms presumably are swallowed, pass through the intact mucosa, enter the lymphatic channels and produce inflammation of the mesenteric nodes, which are particularly numerous in the ileocecal region. The signs and symptoms may exactly simulate those of acute appendicitis and there is no certain way to differentiate between the two conditions.

The symptoms and signs of food poisoning may imitate those of acute appendicitis. The products of many micro-organisms have been found to cause intestinal upsets. These attacks are usually ushered in by violent vomiting and diarrhea, associated with abdominal pain. Localized tenderness is rare. The tenderness often follows the course of the colon. When diarrhea is the first symptom or when nausea and vomiting precede pain, the patient is not likely to be suffering from acute appendicitis. However, as in all generalizations, there are exceptions. In such instances, the physical findings may provide the deciding evidence.

Acute primary peritonitis is extremely difficult to differentiate from acute appendicitis complicated by perforation and peritonitis. These obscure infections are by no means confined to female children, although the vagina and Fallopian tubes are frequent portals of entry. However, the patient is sicker from the onset; the fever is higher; the additional signs are more generalized; and diarrhea is more apt to be associated with primary peritonitis than it is with appendicitis. It is evident that the manifestations of the disease are not distinctive and in some instances the diagnosis can not be made until the character of the peritoneal exudate is investigated.

The early symptoms of acute tonsillitis, lobar pneumonia, diaphragmatic pleurisy, renal pathology, and acute lesions of the spine and hip may be largely abdominal. The differentiation of these conditions has already been considered.

C. TREATMENT

When the inflammatory process is confined to the appendix, there is universal agreement that the only form of treatment advisable is immediate removal of the diseased organ. If this procedure is adhered to, the mortality rate from appendicitis is negligible. The few deaths that do occur are caused by some uncontrollable factor, such as pulmonary embolus, which hazard always exists following any major surgical undertaking.

If the appendix has ruptured and a localized inflammatory mass is found on initial examination, it appears logical not to interfere with the defensive mechanisms of the body which come into play in walling off the infection before operation is performed. This may result in a short delay, but when the abscess is drained through a small incision, there is less likelihood of contaminating the entire peritoneal cavity. It is always a temptation, when draining an appendiceal abscess, to remove the offending organ at the same time. If the appendix is easily exposed after evacuation of the pus, it can usually be removed before closing the wound, without undue risk. But if the appendix is not readily accessible and if its exposure necessitates the breaking down of protective barriers about the abscess, the mortality rate has been shown to be lower if the appendix is not disturbed. In such instances appendectomy may be performed with safety from six weeks to three months later, after the acute inflammatory process has subsided.

Those instances in which the appendix ruptures early in the course of the disease, before the peritoneal cavity has had time to mobilize its defensive forces, offer a more serious problem. The physical findings tend to be of a generalized rather than of a localized nature. The acute general tenderness and rigidity suggest rapidly spreading peritonitis. While the treatment of this form of the disease has been the subject of wide controversy, there is increasing evidence to show that operation with removal of the source of infection has more to offer than conservative treatment.[3] This is particularly true in children for it has been convincingly shown that they do not

tolerate peritonitis nearly as well as adults.[4] They can not endure the starvation of the Ochsner mode of therapy and it is extremely difficult to obtain the co-operation that is so essential to the success of this form of treatment.

In recent years there has been a tendency toward less and less drainage following removal of a ruptured appendix. Those ascribing to this practice believe that it is impossible to drain the entire peritoneal cavity and that the drain acts as an irritating foreign body which hinders the natural defensive processes of the peritoneum.[5] This may be true as far as generalized peritonitis is concerned. However, until more conclusive evidence is offered as to the efficacy of this form of treatment in the more localized types of peritonitis, I have compromised to the extent of inserting a black, soft rubber, split tube drain for a short period. Such a drain rapidly establishes a sinus tract and is the only one which encourages drainage instead of blocking it. Elevation of the drain on the third postoperative day and removal two days later eliminates the danger of the development of a fecal fistula. In cases of perforation of retrocecal appendices such drainage tends to forestall the formation of a subdiaphragmatic abscess. The peritoneum is closed about the drain and the rest of the wound is loosely approximated with one or two through-and-through silkworm sutures. Such a procedure minimizes the likelihood of serious infection of the wound and of the adjacent abdominal wall.[5] Furthermore, the incidence of postoperative ventral hernia is less than if the wound is carefully sutured.

ACUTE INTESTINAL OBSTRUCTION

Acute intestinal obstruction is especially dangerous in children because they do not tolerate shock, dehydration or toxemia. In addition, the obstruction in young patients is frequently situated high in the intestinal tract, which makes the situation much more serious. The etiologic factors are somewhat different than in an adult. Con-

genital atresias, stenosis by bands, intussusception and obstruction by Meckel's diverticula are common in childhood but rare in adults. Postoperative obstruction is probably the most frequent form encountered in adults, but this is not so in children. Tumors are much rarer in the young than in adults.

A. SYMPTOMS AND SIGNS

The three cardinal symptoms of acute intestinal obstruction are pain, vomiting and constipation. The onset of the pain is sudden. The child often cries out and the legs are drawn up. At first the pain is colicky in character, but soon becomes constant. Early in the course of the disease the discomfort is felt in the region of the umbilicus; but when the colon is obstructed, the pain may be more marked in the lower part of the abdomen. Not infrequently, varying degrees of shock are detected at this stage of the illness.

Vomiting begins almost immediately. The frequency and persistency of the vomiting are distinguishing features of the condition. When on the third or fourth day the late sign of fecal vomiting makes its appearance, it is pathognomonic. The constipation is absolute. The administration of an enema may result in the emptying of the intestine below the obstruction together with the passage of a small amount of flatus. This may lead to an erroneous diagnosis of incomplete intestinal obstruction.

On examination, the temperature is generally about normal, the pulse rapid and feeble and the child appears frightened. The hernial orifices should be examined, and in the newly born infant the anus must not be overlooked. Palpation of the abdomen is of most value before distention occurs. Voluntary resistance and generalized tenderness are frequently detected at this time. Distention is a late sign of the disease and is only pronounced in low intestinal obstruction. Visible peristalsis is not common in acute obstruction. Audible peristaltic sounds of a tinkling variety at

the height of the intermittent abdominal pain characterize intestinal colic.[6] If the viability of the intestine is not impaired, there is usually no localized or rebound tenderness of the abdomen or true rigidity of the abdominal muscles. In case there is doubt as to the diagnosis, a flat plate of the abdomen or a barium enema may yield much information, but these procedures are not required ordinarily. Needless to say the barium should never be given by mouth.

B. TREATMENT

Success in the treatment of acute intestinal obstruction in children depends almost entirely upon the speed and accuracy with which the diagnosis is made and upon early operation, for the condition is as rapidly fatal as in adults. Saline solution given parenterally in amounts sufficient to promote a satisfactory urinary output, depending on the age of the child, is almost a specific for the dehydration and chloride deficiency encountered in intestinal obstruction. The administration of a cathartic or morphine before a definite diagnosis has been made is distinctly contraindicated. An enema may be tried, but never a cathartic, if there is any suspicion of an acute obstruction. Pituitrin, pitressin, or prostigmin are given at times when the obstruction is incomplete, but their use is dangerous in cases of acute obstruction.

The actual operation depends on the cause of the obstruction and the vitality of the involved intestine. Unless there is definite evidence to indicate in which portion of the abdomen the obstruction is located, a paramedian incision which can be enlarged either upward or downward will give ready access to any portion of the intestinal tract. Bands or adhesions can be divided and any strangulated loop of bowel freed quite easily. If a portion of intestine appears to be no longer viable, the question of resection arises. Not infrequently after the strangulation is relieved, the dark color of the bowel is found to be due to extensive hemorrhage into the wall. The prompt or

gradual return of the circulation to the part can be detected in these instances and resection is not necessary. However, when resection of intestine is required, because of the high mortality of such a procedure in children, it is often best to leave the gangrenous loop outside of the abdomen either with or without a short-circuiting lateral anastomosis.

After operation some time must elapse before the fatigued intestine can resume its tone and function. Purgatives, stimulants, and copious enemas are not required. Water should be restricted by mouth and the fluid and crystalloid balance maintained by supplementary injections of saline solution. Sedatives and morphine are helpful. Hot fomentations placed on the abdomen are comfortable and promote recovery of intestinal tone. At times, when co-operation can be obtained, the decompression can be aided by applying constant suction to a small nasal tube which has been passed into the duodenum.

HERNIA

For all practical purposes, the only external hernia which may become obstructed in children is the inguinal hernia. An irreducible inguinal hernia is not uncommon. If the patient is placed in the Trendelenburg position and an ice cap applied, the intestine may return to the abdominal cavity. At times strangulation of the bowel occurs. In such instances the child may scream from pain. Vomiting develops as well as absolute constipation. Relief of the condition by early operation is essential.

INTUSSUSCEPTION

Intussusception accounts for at least 75 per cent of all cases of acute obstruction in infancy and childhood. Although found at any age, it is commonest between the ages of six months and two years. Any portion of the intestinal tract may be involved, but the enterocolic form is encountered most frequently. The condition appears to be less common than formerly. This may be due to the greater care taken

in the feeding of children during recent years.

A. DIAGNOSIS

Ordinarily it is not difficult to make the diagnosis. A child who has previously been in good health and suddenly develops acute abdominal pain which comes on intermittently and is accompanied by shock, tenesmus, the passage of bloody mucus by rectum, the presence of a sausage-shaped abdominal tumor, and later by increasing distention and vomiting, is undoubtedly suffering from intussusception. It is important for the physician who is called first not to be misled by the healthy and happy appearance of the child between the attacks of pain. He should wait for an attack before leaving, because otherwise he may be deluded into a false sense of security and thus may delay institution of early, life-saving surgical treatment.

Enterocolitis is the condition which is probably the most difficult to differentiate from intussusception during infancy. However, in this disease there is usually a preliminary diarrhea without blood; the stools contain more fecal material and are more frequent; the abdominal pain is less intense; tenderness is noted along the course of the entire colon; and finally, there is no abdominal tumor.

B. TREATMENT

From time to time nonoperative methods have been advocated in the treatment of intussusception.[7] Reduction by rectal injection of either air or fluid has been employed. However, these measures are not without risk, for not only is valuable time lost if the treatment is unsuccessful, but there always remains some question whether the refractory last inch of the involved intestine has been completely reduced.

Early operation,[8] that is, within the first twenty-four hours, is the only method of treatment in which there is any certainty

of recovery. This is due to the fact that in most instances the intestine is viable and the intussusception can be fairly easily reduced if the attempt is made within a few hours after the onset. Late operation entails grave risk with a mortality varying from 50 to 80 per cent, particularly if resection of gangrenous intestine is required. When the intestine becomes strangulated, it is thickened and friable, and reduction is extremely difficult. While many times the bowel appears to be excessively damaged, it is surprising how much recovery can take place. A glistening loop of intestine, although quite severely injured, should be replaced into the abdomen. Resection in such cases, especially in infants, is almost invariably fatal, while recovery of the damaged intestine is the rule. Excision of a Meckel's diverticulum or removal of the appendix had best be deferred. Various types of resections and short-circuiting procedures have been performed, if the intussusception is irreducible. However, if the intestine is no longer viable, it may be best to bring the mass out of the abdomen and leave a double enterostomy. Edematous, distended bowel is poor material with which to make an anastomosis. Since the operation is a life-saving measure, all other considerations are of secondary importance. From these facts it is readily discernible that the essential factor in improving the mortality rate in intussusception is a reduction of the time between the onset of symptoms and the surgical operation.

INFECTION OF THE URACHAL REMNANT

The urachal remnant is a rare source of acute abdominal infection, usually originating at or near the umbilicus. Ordinarily an abscess develops in the abdominal wall, which may appear to be intraperitoneal. Subsequent invasion of the peritoneum may occur. Early operation with drainage of the abscess is indicated. Removal of the urachal remnant should be deferred until a safer period when the acute inflammation has subsided.

MECKEL'S DIVERTICULUM

Meckel's diverticulum results from persistence of a portion of the omphalomesenteric duct. It is present in about 2 per cent of individuals and is attached to the ileum approximately two to three feet proximal to the ileocecal valve. It often persists throughout life without producing symptoms or it may cause at any time, but particularly in childhood, intestinal hemorrhage, acute inflammation, perforation, peritonitis or intestinal obstruction. When acutely inflamed, it presents symptoms quite similar to those of appendicitis. Differentiation of the two conditions is extremely difficult except in instances in which the pain from the diverticulum is located in the left iliac fossa or in which there is intestinal hemorrhage. A Meckel's diverticulum must always be ruled out when a history of intestinal bleeding is obtained in a child. If the abdomen is opened because acute appendicitis is suspected, and the appendix is not found to be inflamed, the intestine should always be explored for the presence of one of these remnants. The treatment is the same as for acute appendicitis.

GALLBLADDER AND PANCREAS

Acute lesions of the gallbladder and pancreas are rare in children, but they should not be overlooked entirely. Acute cholecystitis, with or without calculi, and gangrene and perforation of the gallbladder, as well as acute pancreatitis, have been reported as occurring during childhood.

TUMORS

There are some abdominal tumors in children which may necessitate emergency treatment. While not common, ovarian masses, usually cystic in character, occasionally become twisted on their pedicle. These lesions can be felt on rectal examination and should be removed before necrosis occurs. Intestinal polyps are rather common. At times, by causing torsion or inversion of the intestine, surgical intervention is requested.

Although ordinarily not classified as an acute disease, there is a pseudotumor of the pylorus, or in reality, hypertrophy of the pyloric muscle, which requires prompt treatment followed by operation a short time later. The congenital form, which is the type under consideration, manifests itself during the first weeks or even during the first days of life. The chief characteristics of the condition are the early development of obstinate, expulsive vomiting, visible peristalsis of the stomach, constipation and a pyloric tumor. The presence of bile in the vomitus is evidence against the existence of pyloric stenosis. Congenital lesions such as atresia of the pylorus or duodenal stricture may confuse the diagnosis but these conditions are rare. An opaque meal may be of some aid in making these distinctions but such a procedure is rarely necessary. After combating the dehydration which is invariably present and improving the patient's general condition, the Rammstedt operation offers the best chance for prompt cure.

SUMMARY

There are some acute surgical conditions frequently encountered in children which are rare in adults. Acute diseases common to both childhood and adult life may manifest themselves differently in the young and require different forms of treatment. In children, it is not unusual for pathological lesions situated in distant parts of the body first to produce referred symptoms in the abdomen. A different technic should be employed when examining young individuals. Success in diagnosis depends upon the ability of the physician to manage the patient.

There is no age limit for appendicitis. The disease in the young is notorious for the rapidity with which it progresses. Prompt diagnosis and removal of the organ before perforation occurs assures recovery. Even when rupture has taken place, eradication of the source of infection offers the best hope of a favorable outcome.

The causes of acute intestinal obstruction in children are not always the same as those found in older patients. Young individuals are unable to tolerate the shock, dehydration and toxemia which accompany the condition. The mortality is high unless immediate relief is obtained.

Intussusception is the most common surgical emergency encountered in infants under two years of age. Reduction constitutes the only safe method of treatment which assures a good chance of recovery. As this is possible only during the early stages of the disease, prompt diagnosis and immediate surgical intervention are necessary to save the child's life.

The urachal remnant and Meckel's diverticulum are uncommon sources of acute abdominal disease. Nevertheless, these structures, as well as abdominal tumors and lesions of the biliary system must be kept in mind when dealing with acute abdominal disease in children.

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LOCAL AND GENERAL TEMPERATURE REDUCTION IN MALIGNANCY

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THE concept of influencing the course of malignant neoplasms by means of low local temperatures was brought to the attention of the profession by the work of Fay and Henny[1] of Philadelphia. Their work began in 1936 and came as a result of correlating segmental temperatures of the body in respect to the locations of primary carcinomas and their metastases. Accessible tumors were subjected to the local application of cold. In an effort to influence metastatic malignant cells in otherwise inaccessible parts of the body, Smith and Fay[2] produced a general lowering of body temperature below the critical level of 95 degrees F. Their clinical results were listed as follows: (1) Reduction of pain; (2) decrease in size of lesion; (3) general improvement in patient's condition; (4) retardation of recurrences; and (5) degeneration of tumor cells as determined by biopsy.

The thought that low environmental temperatures might have a retarding or destructive effect on immature, undifferentiated malignant cells is not a new one; but while the subject has received considerable attention from a number of investigators during the past ten years, the studies reported have been applied to tissue cultures and to laboratory animals. The general reduction of body temperature has also received some attention in connection with studies on general body nutrition and metabolism.[3][4][5] Smith and Fay, however, first produced critical states of hypothermia, as low as 85 degrees F. in human subjects.

Our experiences with this method of influencing malignant growths have been confined to a series of fourteen patients suffering from far advanced and inoperable cancers. Most of these patients had received deep x-ray therapy in dosages to the limit of tolerance.

The purpose of this paper is a presentation of this series with end results and the technic employed.

LOCAL APPLICATION OF COLD

The refrigeration apparatus used for the local application of cold was composed of a thermostatically regulated, water cooling unit and a circulating pump, the mechanism being controlled by a needle valve, a pressure gauge, a flowmeter and thermometers on the outlet and inlet lines. Cold water was circulated at a constant temperature through specially constructed applicators. These applicators are best illustrated by those used in connection with carcinomatous lesions of the breast. A plaster cast was molded to fit the tumor, the breast and the axilla, and from this cast a form was poured. Copper sheets were pounded to the form to obtain an applicator that made perfect apposition with the area marked off for refrigeration. Nickel and chromium plating were applied.

Local refrigeration was used in several instances for as long as 400 to 500 hours at temperatures of 48 to 50 degrees F. Cold was applied continuously except for short intervals when the applicators were re-

moved for observation or because of local complications. Superficial areas of the tumors became necrotic and were cut away from time to time. Microscopically, sec-

four hours and a reduction in size of the tumor mass.

Some work has been done in connection with the depth to which low temperatures

CHART 1

Patient	Location of Primary Lesion	Previous Treatment	Metastatic Lesions	Biopsy Report	Local Cold No. Hours	General Cold No. Hours below 90°F.	Drugs General Cold
1. K. H.	Breast	Palliative mastectomy; x-ray	Liver	Ca.	346	None	
2. A. E.	Cervix	Radium	Pelvic extension to rectum	Ca.	~92	None	
3. J. L.	Prostate	X-ray	Lung and bone	None	None	120	Nembutal 18 gr. Luminal 5 gr.
4. G. C.[1]	Ovary	Exploratory; x-ray	Pelvic extension	Ca.	240	10	M.S. gr. ½ Nembutal 9 gr. Paraldehyde dr. 2
5. G. C.	Ovary	See above	See above	See above	See above	48	Nembutal 33 gr.
6. I. K.	Bladder	Fulgeration; x-ray	None	Ca	384	51	Pentothal 9½ gr. Nembutal 10½ gr. S. Luminal 35 gr.
7. A. L.	Breast	Surgery; x-ray	None	Ca.	504	53	Nembutal 6 gr. S. Luminal 32 gr.
8. M. L.	Breast	Surgery	None	Ca.	504	54	Pentothal ~1½ gr. Nembutal 6 gr. S. Luminal 38 gr.
9. W. D.[2]	Rectum	Surgery; x-ray	Perineum; vulva; inguinal glands	Ca.	236	....	Nembutal 16½ gr. Pentothal 7½ gr. S. Luminal 16 gr.
10. W. D.	Rectum	See above	See above	See above	See above	38	Nembutal 38½ gr.
11. Z. J.	Breast	X-ray	None	Ca.	504	2½	Pentothal 5 gr. Nembutal 15 gr.
12. Z. J.	Breast	X-ray	None	Ca.	See above	30	Nembutal 25 gr.
13. C. B.	Cervix uteri	X-ray	Lung?	Squamous Ca.	.....	48	Nembutal 34 gr.
14. P. D.	Stomach	Exploratory; x-ray	Abdomen	Squamous Ca.	....	~2	Nembutal 29¾ gr.
15. E. Q.	Foot	X-ray; surgery	Inguinal lymphnodes	Melano sarcoma	...	48	Nembutal 29 gr.
16. T. L.	Lung	X-ray	Lung	Bronchogenic carcinoma	.....	55½	Nembutal 1~1½ gr.
17. M. J.	Breast	Surgery; x-ray	General	Ca.	.....	27	Nembutal 29¼ gr.

[1] Second general treatment.
[2] Unable to depress temperature below 94.6°F.

tions of these pieces showed cell necrosis. In several instances there were areas of sloughing in normal tissue. This superficial necrosis with sloughing was practically constant over the tumor tissue but was infrequent in normal tissue. The greatest depth of necrosis was 6 mm. Clinically, we observed relief from pain within twenty-

applied to the skin are effective. Zondek[7] reported that an ice bag applied to the thigh caused a fall of temperature, at a depth of 50 mm. from 37.1 degrees c. to 36.3 degrees c. in one hour, when the skin temperature had fallen to 7 degrees c. An ice bag applied to the abdomen of an obese subject (fat, 50 mm.) for one and one-half

CHART 11.
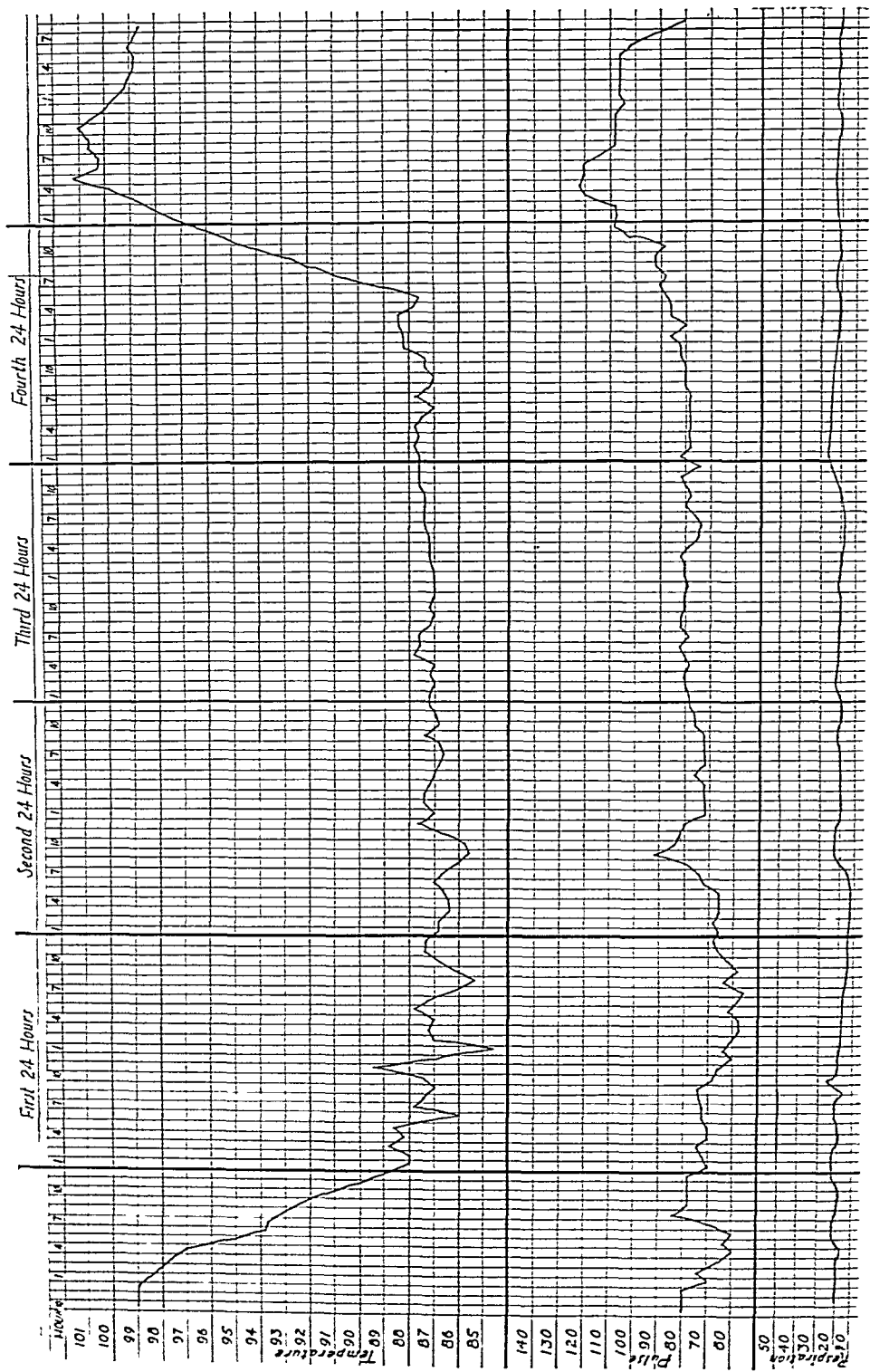
hours caused a fall of skin temperature to 6 degrees c., but the abdominal muscle temperature, at a depth of 50 mm., fell only from 37.6 degrees c. to 36 degrees c., and cold applied locally to the surface of an accessible tumor of moderate size, e.g., with a 2 cm. diameter, has more than a superficial effect. However, several factors

CHART III

Patient	General Cold; No. Hours below 90°F.	Blood R.B.C. Millions				Blood W.B.C.—M.				Differential Neutrophils—M Small Lymphos—M.			
		Before Treat.	1st 24 Hours	2nd 24 Hours	3rd 24 Hours	Before Treat.	1st 24 Hours	2nd 24 Hours	3rd 24 Hours	Before Treat.	1st 24 Hours	2nd 24 Hours	3rd 24 Hours
1. K. H.	None	4.3	4.5	...	...	9.0	9.0	....	...	8.3 / 0.5	7.2 / 1.8		
2. A. E.	None	4.4	...	...	3.1	8.0	....	....	16	4.3 / 2.4			
3. J. L.	120	3.3	4.2	4.2	3.8	8	14	12	10	6.1 / .56	13.2 / 0.48	11.5 / 1.0	8.3
4. G. C.	10	3.8	4.6	4.2	...	12	22	24	15	10.2 / 1.2	19.1 / 2.9	20.9 / 1.9	13. / 1.5
5. G. C.¹	48	4.1	4.0	4.5	4.3	8	12	18	9	6. / .96	10.3 / 1.2	17.3 / 0.7	7.4 / 1.3
6. I. K.	51	4.4	...	4.8	...	6	....	14	...	4.8 / 0.8	..... /	12. / 1.6	
7. A. L.	53	4.0	5.5	...	...	8	20	....	...	5.4 / 2.1	17 / 2.6		
8. M. L.	54	3.8	4.5	4.6	3.8	7	20	40	26	5. / 1.6	18 / .6	36 / 1.2	23 / 2.6
9. W. D.²	None	4.4	4.8	...	...	9	26	....	...	5.8 / 2.8	23.4 / 2.5		
10. W. D.¹	38	4.0	5.5	...	...	12	24	....	...	10.5 / .96	22		
11. Z. J.	2½	4.0	...	...	...	12	....	....	...	8.6 / 2.5			
12. Z. J.¹	20	4.2	5.0	...	...	8	20	....	...	5.6 / 2.	18 / 1.6		
13. C. B.	48	2.4	4.5	4	3.2	6	10	11	14	4.3 / 1	8.3 / 1	9.6 / 1.3	12.5 / 1
14. P. D.	72	5.3	6.8	6.4	5	9	9	5	4	6.6 / 2.1	7.5 / 1.2	3.5 / 1.3	3.2 / .72
15. E. Q.	48	4.4	5	5	...	10	8	16	...	6.4 / 3.2	5.8 / 1.8	14.6 / .8	
16. T. L.	55½	3.5	5	5	4.2	10	14	5.5	12	7.7 / 1.1	12.4 / 1.2	4.6 / 6.6	11.2 / .72
17. M. J.	27	4	5.6	...	...	7	12	....	...	2.5 / 3.2	6 / 3		

¹ Second treatment.
² Unable to depress temperature below 94.6°F. See Chart 1.

then attained equilibrium. Harkins and Harmon[8] have made some measurements on subcutaneous temperature reduction following the local application of cold.

These studies suggest that the depth of heat loss beneath local cold applicators is not great, and it is questionable whether must be considered. Cold applied locally gains its depth effectiveness by withdrawal of heat from within the body; and, theoretically, a cold applicator would eventually exhaust body heat if heat production was not increased above the normal rate. Since, however, body heat production is

CHAPTER IX

[illegible degraded table]

¹ Second treatment
² At no time did temperature fall below 94.6°

equilibrium, heat supply balancing heat loss.

HIBERNATION

General hypothermia, "hibernation," was produced fourteen times in twelve

of both, previous to hypothermia. Arbitrarily, a temperature of 90 degrees F., or less, was used in determining the duration of hypothermia.

Three methods of applying external cold were used: ice packs, ice bags and the

continuous flow tub. Ice bags were quite satisfactory for most patients, ice packs and the continuous flow tub being used for those who were relatively more obese. Ice was more conveniently handled when placed in ice bags, and variations in the cold environment were more easily and more quickly obtained. Room temperature was maintained at 45 to 50 degrees F.

The patients were given nembutal in 1½ gr. doses at half-hour intervals until adequately narcotized. If adequate narcosis was not obtained by nembutal, gr. 7½, by mouth, a 5 per cent solution of nembutal was administered intravenously until a stage of light surgical anesthesia was teached. For maintainance of the narcorized state nembutal was given intramuscularly in ¾ gr. doses at necessary intervals. It has been pointed out that nembutal itself has a slight depressing action on body temperature and lowers the temperature that must be reached by the body to initiate the shivering reflex. Kohn-Richards and Grimes[9] found that in experimental animals high temperatures in general increase the toxicity of nembutal while low temperatures decrease toxicity. This decrease in toxicity is present until a certain temperature level is reached, after which point toxicity increases. In frogs, 10 degrees C. appears to be a critical level below which the toxicity of nembutal rises.

A certain amount of narcosis is necessary to prevent increased muscular tension, restlessness and shivering, factors which tend to elevate a subnormal temperature. Swift[10] showed, by exposing human subjects in a basal state to an environmental temperature of 2 degrees C. for periods of more than one hour, that heat production is proportional to the amount and to the intensity of shivering; and he concluded that any increase in metabolism that is not accompanied by definite shivering, may be justly ascribed to increased muscular tension. He concluded that shivering increases the metabolism approximately 400 per cent. Effective narcosis eliminates shivering and brings about muscular relaxation.

Temperatures were taken with electric resistance thermometers, either indicating or recording type. These instruments are more accurate than the ordinary clinical variety. The bulbs were inserted into the rectum for a distance of 10 cm. These deep rectal temperatures were checked by vaginal, axillary and colostoma temperatures and also by measuring the temperature of catheterized urine. The temperature in a stream of urine is 0.3 to 0.5 degrees F. below rectal temperature.

There was a rather constant and sharp drop in temperature during the hours between 3:00 and 6:00 A.M. When the temperature dropped too quickly, or fell below a predetermined level, ice was removed, in whole or in part, and sedative drugs were withheld until there was some indication that the fall had been interrupted. Heat was applied to the extremities but with caution. Sudden change from a cold to a warm environment produced rapid respiration, a very rapid and shallow pulse and restlessness. During the induction stage we allowed the temperature to drop at the rate of approximately 1 degree per hour until the level of 86 to 87 degrees F. was reached. In one instance, because of too heavy initial narcosis, the temperature fell from 98.6 degrees F. to 86 degrees F. in a period of two hours. The patient presented a rather severe state of collapse, but was restored satisfactorily following removal from the ice pack.

The temperature ranges used in this series were purely arbitrary, representing, we believed, a satisfactory reduction below the critical level of 95 degrees F. Britton[4] recorded instances of rectal temperatures in human subjects reaching as low as 75 degrees F. with eventual recovery. In homothermal animals temperatures may be depressed to 60.8 degrees F. without any demonstrable ill effects following recovery.

To establish a workable technic for the production of hypothermia we set a limit of forty-eight hours, during which the temperature was maintained within the determined range. Following the required

number of hours at temperatures ranging between 85 and 87 degrees F., the ice pack was removed gradually and the patient was placed in bed at room temperature. Ice bags were kept to the head. Body temperature rose slowly, reaching normal in eight to ten hours. Frequently the temperature remained elevated to 99 or 100 degrees F. for twelve to twenty-four hours after recovery. Fluids were given parenterally until the patient was able to swallow and at that time liquids and soft foods were given as tolerated.

One obese patient, age 33, height sixty-five inches, weight 185 pounds, basal metabolic rate −13, was packed in ice for thirty hours with no temperature reduction below 94.6 degrees F. A second attempt was made using the continuous flow tub. During the first four hours, the temperature failed to drop below normal. Following the administration of insulin, seventy-five units during the next twenty-four hours, body temperature was reduced to 85.2 degrees F. The lowest blood sugar determination was 19 mg. per cent. During the remainder of the period of hypothermia temperature rises were obtained by the use of adrenalin or glucose intravenously, and temperature drops were obtained by the use of small amounts of insulin. Recovery was uneventful.

Suomalainen[11] produced hibernation in warm blooded animals by the intravenous injection of insulin and magnesium chloride. He found that these substances caused a drop in blood sugar content to less than half normal in European hedgehogs and produced a cold-blooded state characteristic of warm-blooded animals in hibernation. The animals remained asleep as long as he kept them in a refrigerator at temperatures near zero centigrade. When he removed them to a warm room, they awoke and returned to a normal warm-blooded state.

The adrenal mechanism has been shown to be specifically concerned in the regulation of body temperature. Britton[4] found that small amounts of adrenalin injected intravenously into animals in which artificial hibernation had been induced, stimulated reactions that tended to bring about a re-establishment of normal body temperature (promotion of glycogenolysis and shivering).

Finney, Dworkin and Cassidy[12], working with animals, produced a condition simulating hibernation by means of insulin and cold and restored the animals with adrenalin and pituitrin.

In none of the patients subjected to general hypothermia was it our experience to note a complete cessation of kidney function. Smith and Fay[15] stated that urinalysis in all of their cases had shown nothing of pathologic significance. All of our patients showed abnormal urinary findings in catheterized specimens taken during hypothermia. Vaughn[16] reports no urinary findings. In our series 5 per cent glucose in normal saline was administered in 1,000 cc. amounts at twelve hour intervals. The urine commonly contained albumin, acetone and casts, both granular and hyalin. After twenty-four hours of temperatures at 86 to 87 degrees F., the urine frequently cleared and remained clear until hypothermia was terminated.

Smith and Fay[15] found no evidence of nitrogen retention in a series of thirty-three cases. In later cases they administered fluids enterally and parenterally in 1,000 cc. amounts daily. In these cases they noticed a slight drop in the average figure for nitrogenous products. We observed rather sharp rises in the blood N.P.N. and the urea nitrogen until we instituted, as a routine measure, parenteral fluids in 1,000 cc. amounts at twelve hour intervals. Even with these fluids there were consistent rises in blood nitrogen values.

Distention was a frequent complication but the oral administration of acidophilous milk three or four days before induction reduced its incidence. However, if distention became a troublesome factor, constant suction by means of a duodenal tube was instituted.

We found a rather constant diminution of respiratory excursion, paralleling the

degree of temperature reduction. When respiratory excursion was shallow and when, at the same time, the patient appeared to be in a low metabolic phase, as evidenced by complete cessation of shivering, decreased muscular tension and diminished response to stimulation, the respiratory rate was decreased. Respiratory rate was depressed as low as ten per minute in one instance. At such times the pulse rate likewise was diminished. The lowest pulse rate recorded in this series was 58. During these phases of extremely "quiet hibernation," the respiratory movements were barely discernible, the peripheral pulses could not be appreciated and extremely small amounts of sedative and external ice were necessary to maintain the temperature evenly at 85 and 86 degrees F. This peculiar physiological state does not resemble deep sleep, surgical anesthesia or the coma seen in connection with the usual pathological clinical entities. It is the physiological state to which the term "hibernation" was applied by Smith and Fay. Whether this state is identical with the hibernation of animals has not been established.

When muscular tension and shivering reappeared following the removal of ice, the respiratory rate increased, respiratory excursion deepened and the pulse rate was accelerated. These phenomena would tend to support the conclusions of Swift that metabolic activity is proportional to the amount and intensity of muscular tension and shivering.

There was a consistent increase in hemoglobin percentage and in the number of red and white blood cells. It is known, that following the application of cold to the skin, the cutaneous vessels are constricted to diminish heat loss and the blood is diverted to the deeper parts of the body. It has been suggested that the fluid part of the blood, which is removed from skin vessels, is stored in the muscles and other tissues so that the hemoglobin percentage and the erythrocyte count may be increased. In our series, the increase in white

blood cell count was due predominantly to an increase in the number of neutrophiles. In view of these findings it is difficult to attribute the change in the white blood cell picture wholly to concentration. Following the third twenty-four hour period there was decrease in the leucocyte count, which may be due to the effect of lowered temperature on the hematopoietic system.[13,14]

One patient died during the period of hibernation. After twenty-seven hours of temperature below 90 F., the patient died, apparently because of respiratory failure. Death was sudden and without any obvious changes previous to that time. This patient was suffering from recurrent carcinoma of the breast with generalized carcinomatosis. Postmortem examination showed diffuse edema of the brain with involvement of the anterior and posterior lobes of the hypophysis and of the dura mater over the cerebrum by metastatic carcinoma.

The only obvious clinical benefit of any appreciable duration was relief from pain. All patients complaining of pain were relieved in whole or in part following hypothermia, either local or general.

Eleven individuals were successfully hibernated. Of these, three are alive following hibernation—three and one-half, four and one-half, and eight months, respectively. The eight patients who have died since hibernation lived three, three and one-half, three and one-half, five, five, six and one-half, seven and seven and one-half months, respectively.

Whether these figures represent any material prolongation of life expectancy in an average group of far advanced and inoperable cancer patients is difficult to determine. It is not unusual for cancer patients who have reached the stage of metastatic extension to live from three to seven and one-half months.

CASE REPORTS

CASE 1.   G. C., a white female, aged 36, had a carcinoma of the right ovary with liver and

peritoneal metastases. An exploratory operation was performed but the cancer was in the inoperable stage. Deep x-ray therapy was administered and hibernation produced September 15, 1939, and November 15, 1939. Death occurred May 12, 1940. The patient experienced relief from pain and gain in appetite and strength for three months. During this time morphine was reduced from 2 gr. daily to ¼ gr. every two or three days. During two months prior to death pain increased, requiring additional morphine.

CASE II. J. L., oriental male, aged 53, had a carcinoma of the prostate with metastases to bone and lung. Deep x-ray therapy was given and hibernation produced August 16, 1939. Death occurred on February 26, 1940. There was no noticeable improvement at any time; considerable hematuria was present for three months prior to death; no pain was felt before or after hibernation.

CASE III. A. E., white female, aged 65, had a carcinoma of the cervix with metastases throughout pelvis and a rectovaginal fistula. Local cold was applied only by means of applicator to vaginal portion of the cervix and in fistula. The fistula was reduced in size but did not close. There was marked relief from pain. Local cold was begun July 12, 1939. Death occurred April 20, 1940.

CASE IV. I. K., white female, aged 42, had a carcinoma of the bladder. Deep x-ray was applied and local cold for 384 hours. Hibernation was produced October 12, 1939. Death occurred March 12, 1940. There was relief from pain and dysuria.

CASE V. A. L., white female, aged 48, had recurrent carcinoma of the breast with pulmonary metastases. Radical operation was performed and deep x-ray given until July, 1939. Local cold was applied for 504 hours and hibernation produced on November 11, 1939. Death occurred May 20, 1940. There was no pain at any time and no evidence of local or general improvement.

CASE VI. M. L., white female, aged 41, had a recurrent carcinoma of the breast with metastases to the sternum and ribs. Radical breast operation was performed and deep x-ray administered in 1936. Local cold was applied for 504 hours. Hibernation was produced November 19, 1939. The patient is still living. Weight gain and reduction in size of mass in sternum followed hibernation and have been maintained to date.

CASE VII. Z. J., white female, aged 49, had a recurrent carcinoma of the breast with pulmonary metastases. Massive x-ray therapy was administered over a period of two years. The cancer was inoperable because of extensive scarring and ulceration following x-ray. Local cold was applied for 504 hours. Hibernation was produced November 25, 1939. Death occurred May 23, 1940. There was a noticeable relief from pain to time of death.

CASE VIII. R. H., white female, aged 46, had a recurrent carcinoma of breast with lung and liver metastases. A radical operation was performed and deep x-ray administered in May, 1939. Local cold was applied for 346 hours. There was noticeable but not complete relief from pain. The patient died November 23, 1940.

CASE IX. W. D., white female, aged 33, had recurrent carcinoma of the rectum with metastases to inguinal glands, perineum and liver. Radical abdominoperineal operation was performed and deep x-ray administered. Local cold was applied for 236 hours and hibernation produced January 9, 1940. Death occurred April 27, 1940. Relief from pain to six weeks prior to death was noticed.

CASE X. T. L., white male, aged 53, had a bronchogenic carcinoma. Deep x-ray was administered ending in August, 1939. Hibernation was produced January 16, 1940. Death occurred April 23, 1940. No pain was present at any time; but there was an annoying cough that showed no change following hibernation.

CASE XI. M. J., white female, aged 42, had a recurrent carcinoma of the breast with generalized carcinomatosis. A radical operation was performed and deep x-ray administered. Hibernation was produced February 27, 1940, but the patient died during hibernation.

CASE XII. E. Q., white female, aged 52, had a carcinoma of right heel with metastases to the groin. Leg amputation with block gland dissection was done and x-ray administered. Hibernation was produced April 1, 1940. Her general condition is good with no evidence of recurrence to date.

CASE XIII. P. D., white male, aged 47, had a carcinoma of stomach with metastases to the liver and peritoneum and ascites. An exploratory operation was performed but the cancer was in the inoperable stage. Deep x-ray was administered February, 1940. Hibernation was produced March 26, 1940. Death occurred June

25, 1940. There was noticeable but not complete relief from pain.

CASE XIV. C. B., white female, aged 49, had a carcinoma of the cervix with pelvic metastases. Radium and deep x-ray were administered; there was no pain at any time. Hibernation was produced March 5, 1940. This patient is now markedly cachectic and has had repeated hemorrhages. No reduction in size of palpable portion of growth.

SUMMARY

1. Fourteen patients with inoperable and far advanced cancers were subjected to local and general hypothermia. The lowest general temperature obtained was 77.6 degrees F.

2. The periods of general hypothermia varied from thirty-six and one-half hours to 120 hours. Periods of local temperature reduction ranged from 236 hours to 792 hours.

3. Twelve individuals were submitted to hibernation. One death occurred during hibernation, apparently because of cerebral edema superimposed on meningeal metastases. Eight deaths occurred three months to seven and one-half months following hibernation. Three patients are living three and one-half, four and one-half and eight months following hibernation. Two patients received only local cold; one lived one month; one lived nine months.

4. All patients complaining of pain were relieved in whole or in part following hypothermia, either local or general.

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PERIDURAL ANESTHESIA: A CONSIDERATION
OF 1000 CASES

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SINCE a preliminary report by one of us (J. R. H.) in 1934[1] we have continued to use peridural anesthesia, making a careful survey of its advantages and disadvantages. To date 800 cases have been operated upon under peridural anesthesia; they include practically the entire range of surgery from the clavicle to the feet.

Every experienced surgeon seeks three factors in the anesthetic he employs: safety, effectiveness and simplicity of application. While no single anesthetic fulfils every requirement, we believe that the peridural method more nearly approaches the ideal.

A perusal of the literature reveals some interesting facts concerning peridural anesthesia. Corning,[2] in 1885, called attention to the possibilities of obtaining anesthesia by the subdural application of cocaine. In 1901, Cathelin[3] in a series of articles described the perisacral method and demonstrated that extensive anesthesia could be produced by placing the preparation outside the dura. He proved that the dura was impervious to the anesthetic solution and, therefore, there was no danger of direct action on the cord structures. He showed that fluids when injected into the sacral canal rise by capillary action in the peridural space to a height in direct proportion to the amount of the preparation used and the speed with which it was forced into the canal. Cathelin found experimentally that the peridural space had an extreme

tolerance, and that more than a liter of fluid could be injected into the spinal canal of an average sized dog. He further showed that when sufficient cocaine solution was injected into the sacral canal of the dog, it resulted in complete anesthesia of the entire body. Though Cathelin's method met with very little success in the earlier years, recently it has been quite generally employed.

Pagés,[4] in 1920, was the first to make use of the peridural space in the lumbar and thoracic regions for obtaining anesthesia in abdominal and chest surgery. In his first few cases of peridural anesthesia he used concentrations of 1:100 for novocain, believing that the anesthesia was mainly one of the nerve conduction of the spinal pairs and that these were surrounded by a dural prolongation. While the results were satisfactory, he soon found that a solution of 2:100 was much better.

Following Pagés' report in 1921, the method was tried by many surgeons in France, Italy and the South American countries. In 1933, Gutierrez and Rubido[5] reported the use of peridural anesthesia in over 3,000 cases, with some failures but no fatalities. They confirmed the advantages claimed by Pagés. They used a 2 per cent novocain solution to which 1 cc. of a 1:1000 adrenalin solution was added.

Dogliotti,[6] in 1933, reported on the use of peridural anesthesia in 300 cases. He considered the method superior to local anesthesia "since it acts both on the superficial

and deeper layers and viscera so that any operation is possible by its use. Anesthesia is moreover so deep that it can only be compared with that obtainable from an ordinary spinal anesthetic. Peridural anesthesia also possesses the advantage, when compared with local anesthesia, of causing no interference to the local nutrition of the tissues. It thus has no delaying effect or hindrance in the course of healing. When compared with general anesthesia it will be seen to possess all the advantages and disadvantages of local and block anesthesia." His excellent article should be studied by all who attempt to obtain anesthesia by the peridural route.

Hess,[7] in 1934, reported seventy-five cases operated upon under peridural anesthesia. He listed as its advantages no shock, no disturbance of the lungs, heart, liver, gastrointestinal tract, and no effect on damaged renal tissue. He noted no postoperative complications. It was his belief that although it is the safest of all types of anesthetics, peridural anesthesia should not be used routinely.

Bogetti[8] reported satisfactory results in 90 per cent of his cases in 1934. He emphasized the absence of dyspnea, headaches, nausea and vomiting. Deformities of the spine, calcification of the ligaments, and errors in technic were responsible for the failures. He was of the opinion that its use was contraindicated in serious cases of advanced heart, lung and kidney disease. He used adrenalin freely, and found that his best results were obtained when he used 50 cc. of the anesthetic solution injected at levels from the eleventh dorsal to the fifth lumbar spaces, depending on the type and location of the operation. He found the duration of anesthesia to be ninety to one hundred twenty minutes.

Sammartini[9] used from 35 to 60 cc. of the solution in the lumbar spaces. From seven to thirty minutes were required to obtain anesthesia. He noted that the pulse changes were slight and the blood pressure changes insignificant. He called attention to one noteworthy fact which we have

found present in 100 per cent of our cases, that with complete sensory paralysis the motor function was still intact. Relaxation was excellent and the anesthesia extended from the chin to the ankles. Nausea was present in about 3 per cent of his cases.

Bertola and Sala,[10] reporting in detail on their work in 1935, called attention to the simplicity of the equipment needed to give the anesthetic and to the minimal of postoperative complications. They considered the method about ideal. They used 20 to 50 cc. of a 2 per cent solution of novocain and found that the anesthesia lasted longer than any other type of nerve block. They did not inject above the tenth dorsal space. They noted that the arterial tension and motor functions were maintained even though the anesthesia lasted from ninety to one hundred twenty minutes.

Babbini[11] reported on the use of peridural anesthesia in seventy-nine cases up to 1935; in sixty-five the results were very good, in four they were good, and in six not satisfactory. He used 20 minims of adrenalin in each 100 cc. of solution and obtained his best results when he injected 50 cc.

Sievers[12] found peridural anesthesia satisfactory in kidney and ureteral work, and particularly in cystoscopy in children. Caporale[13] also used it in kidney and ureteral cases, reporting on 300 cases in 1936. He injected 2.5 per cent solution into the eighth to the eleventh dorsal spaces. Like many other workers, he recognized the negative pressure in the peridural space. He used a type of manometer so that when the needle entered the triangular space the fluid in the manometer moved toward the needle, thus indicating that the needle point was properly placed. Caporale recommended injecting 10 cc., waiting three or four minutes and then injecting another 10 cc., again waiting and finally injecting 10 or 20 cc. He reported no postoperative complications.

Ruiz[14] and his associates at the clinic of Professor Alberto Gutiérrez employed peridural anesthesia in 3,826 cases from

1932 to 1939. He reports two serious accidents caused by the anesthetic and three fatal cases in which it is certain that death was not caused by anesthesia, though no necropsies were done.

The patients in this series varied in age from fifteen to seventy-eight years; they underwent a variety of operations, such as gastrectomy, gastroenterostomy, resection of the intestine, abdominoperineal procedures, appendectomy, herniorrhaphy, cholecystectomy, cholecystostomy, operations for cysts of the liver, nephrocolopexy, nephrostomy, nephrectomy, operations for retroperitoneal tumors, Albee operations with costal graft, osteotomy, amputation, and extirpations of the mammary gland including the pectoral muscles and axillary glands.

Their conclusions are interesting: "It is admitted that peridural anesthesia is not perfect, inasmuch as there is some risk attached to its use, but it is equally undeniable that, so far, it seems to be superior to the method of anesthesia commonly used. It is safer than spinal anesthesia because it has all the advantages of that method and none of its disadvantages (bulbar accidents, cephalea, rachialgia, paralysis, vomiting, etc.). It is better than anesthesia with ether or chloroform because it is much less toxic, it may be used in cases when ether or chloroform are contraindicated; it may be repeated without furthur inconvenience and the postoperative stage is excellent. Local anesthesia is less toxic, but it cannot be used for nervous high-strung patients; it requires greater anatomic skill on the part of the surgeon and a very accurate diagnosis to avoid exploratory maneuvers, and it takes much time—a serious drawback. Pagés' peridural anesthesia represents real progress in surgery."

TECHNIC

The fundamental principles of technic do not differ from those laid down by Cathelin[1] thirty-five years ago. We have modified some of the details of technic and enlarged the scope of its usefulness. Our procedure is as follows:

Premedication. Most surgeons favor some form of premedication with all types of anesthesia, except possibly in small children. We have found that morphine with or without scopolamine or atropine in doses to suit the individual patient has been quite satisfactory.

Position of the Patient. The anesthetic is given while the patient is lying in the lateral prone position, and he remains on his back with the table level during the operation, or in any position required for the given operation. No attempt is made to influence the extension or spread of the anesthetic by changing the position of the patient.

Control of the Patient. The patient should understand what the operator wishes to accomplish. With proper technic and sufficient time for the anesthetic solution to take effect, success will be obtained. A competent assistant who can divert the patient's attention and offer reassurance is very valuable in some cases but not essential.

Equipment. The apparatus required for administering peridural anesthesia is quite simple. We have on the table a 2 cc. and a 10 or 20 cc. syringe, with a fine hypodermic needle about 3 cm. in length, and a relatively fine spinal needle with a short beveled point, and two medicine glasses. The ordinary hypodermic syringe is used to anesthetize the point of spinal puncture. One medicine glass is for normal salt solution which we frequently use although it is not essential. The second one contains the anesthetic solution. We have used in most of our work a 2 per cent solution of novocain or procaine in normal salt.

Procedure. The point of insertion of the spinal needle in all cases has been as near the midline as possible. The level at which the needle is placed is controlled, in great part, by the type of operation contemplated. For all pelvic, perineal, and lower extremity work we select the second to the fourth lumbar interspace. For upper

abdominal work the peridural space is entered at about the ninth dorsal to the first lumbar interspace, while for chest operations we place the needle in the peridural space in the middorsal region.

With the insertion of the spinal needle one obtains a sensation of release as the needle passes the deep margin of the interspinous ligament and enters the peridural space. When this sensation is noted, we withdraw the stilet and look for the spinal fluid. The needle may be rotated and the syringe attached in an attempt to obtain spinal fluid. If no fluid is seen or we have a dry tap, we know the needle has not entered the dura. If spinal fluid is secured, we have in most cases withdrawn the needle and repeated the puncture one segment higher or lower. Odom[15] recommends inserting the needle until spinal fluid is found and then withdrawing it until the fluid no longer escapes. This we do not advise as it removes one of our safeguards.

When we believe that the needle is in the proper space we attempt to inject normal salt solution. If, perchance, the needle is still in the interspinous ligament, no solution can be forced in except by great pressure on the plunger. If this be true, with the syringe still attached, the needle is then rested a little deeper; and when the triangular peridural space is reached, a negative pressure will be noted and the fluid enters almost with a suction. In either instance, when the point of the needle is in the peridural space, the salt solution or the anesthetic solution may be injected with the slightest pressure on the plunger. At this time 5 to 7 cc. of the 2 per cent novocain solution are injected, the syringe removed and the stilet replaced in the needle. We wait five minutes, the time being carefully noted by the nurse. The patient is then asked to move his feet and to respond to the needle prick in the buttocks. If the response is positive in both instances, it is evidence that the anesthetic solution rests outside the dura, otherwise the patient would have a complete anesthesia and his response would be

negative. (On three occasions this has happened and the operation was carried out satisfactorily without further injection of the anesthetic.) At this point, if a drug reaction is noted, no further solution should be injected.

With a positive response another 40 to 45 cc. of the solution are injected slowly, making frequent inquiries as to the patient's sensations and well being. The spinal needle is then withdrawn and the patient asked to turn on his back, which he invariably does without assistance. The next ten minutes are consumed in the preparation of the operative field. At the end of this time the anesthesia is usually complete. In some cases a longer interval is required. With the same technic an occasional case will require fifteen to twenty-five minutes for complete anesthesia.

The Use of Adrenalin. In our early work we used 5 to 10 minims of adrenalin as a routine. We found in some cases that it increased the excitability of the patient. Any patient entering the operating room in a conscious condition will have sufficient nervous reaction to produce an increase of his own adrenalin secretion, which is in excess of his needs; therefore, by injecting 5 to 10 minims of adrenalin hypodermically we found in some cases that it produced what we have termed a hyperadrenalism with definite nervous manifestations. During the last five years we have reserved the use of adrenalin for those cases in which the blood pressure falls relatively out of proportion to the patient's well being, or in which psychic shock or drug reactions are severe. In most cases it restores the blood pressure and pulse in a few minutes. Coramine has been used in a few instances and in less than one in one hundred oxygen and carbon dioxide have been resorted to because of slow shallow respirations. In the last 400 cases we have had no serious reactions.

ANESTHETIC EFFECTS

A mental survey of the spinal canal will show one that there is no other exit for

the anesthetic solution except through the intravertebral notches once it is placed in the spinal canal outside of the dura. While
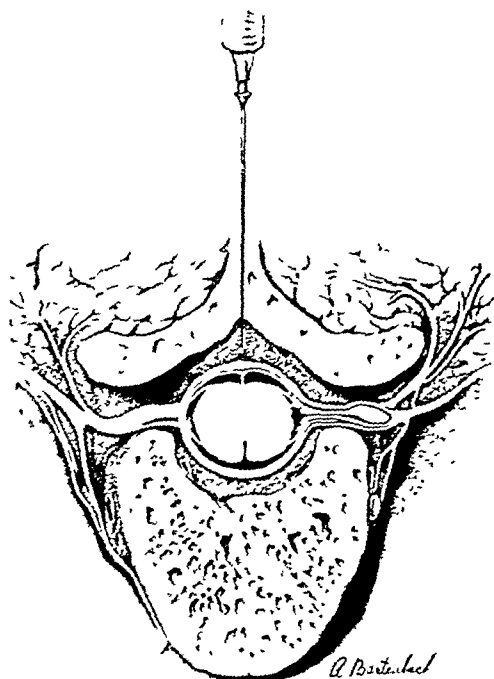
FIG. 1. Semidiagrammatic section through lower dorsal region. Relative size and outline of the peridural space is shown. Needle point rests in the triangular space, which is more pronounced in the lumbar region. The nerve roots are shown beyond the dural sheath with their communicating branches to the sympathetic ganglion on the right. Stippling shows how the anesthetic solution bathes the nerve roots, the communicating branches and the sympathetic trunks.

passing through the intravertebral notches, the line of least resistance is following the nerve roots that are no longer covered with the dura mater, and in close proximity to the roots are the communicating branches to the spinal sympathetic ganglion, all of which are bathed in the solution. (Fig. 1.)

When 50 cc. of a colored solution were injected into the peridural space of a cadaver, it was found coming through from six to ten intravertebral notches. When 50 cc. of a 2 per cent novocain solution in normal salt are injected into the lower dorsal or lumbar peridural space of the patient and sufficient time has elapsed,

usually ten to fifteen minutes after injections, complete sensory anesthesia develops and a vasomotor constriction is noticed. The motor function is affected only in part.

We have recorded relatively few complete failures in our work. In each of these a careful review of the various factors involved has revealed imperfect technic. In two cases spinal curvature caused the needle to find its way into the wrong location; in three others spinal bony changes made it impossible to place the needle properly and this type of anesthesia was abandoned in favor of a general anesthetic. The loss of sensation extended from the nipples to the knees in all cases in which anesthesia has been obtained, and in many cases it extended from the clavicle to the toes. The motor functions were never lost completely. It is interesting to note that the patient can move his feet throughout the operative procedure and in many cases will move himself from the table to the cart following operation.

Throughout the operation the color of the skin about the anesthetized field remains good and capillary bleeding is notably absent. Respirations are slow and quiet and there is an entire absence of that churning motion of the viscera in the upper abdomen that is so objectionable under general anesthesia. Abdominal muscular relaxation is extreme and this facilitates exploration and study of intraperitoneal pathology as no other anesthetic will do. The small intestines are contracted. Manipulation of the abdominal viscera and all operative procedures are made so easy that the use of lap pads is reduced to a minimum. Rarely are any of the peritoneal contents forced into or through the operative wound. Closure of the abdominal incision is done with the greatest ease. Nausea during or after operation rarely occurs, and vomiting in not more than 2 or 3 per cent at any time.

SYSTEMATIC REACTIONS

Idiosyncrasy to drugs is a surgical problem not yet solved. That some patients

react adversely to novocain and other preparations is quite evident. We have experienced no little difficulty in differentiating drug reactions, psychic and nervous shock, hypo- and hyperadrenalism, and toxic shock. Every surgeon of experience has noted these various reactions even during minor surgical work under local anesthesia. We find the psychic reactions are usually transient and pass off in a few moments, but in some cases they lead to the more serious condition of real anatomical shock. Drug reactions are more persistent and difficult to handle.

Disturbances due to adrenal imbalance, especially the hypophase, frequently respond readily to treatment, and after our discontinuance of the use of adrenalin as a routine the hyperphase rarely occurs. In the hypoadrenal condition with an extensive fall in blood pressure, ten to fifteen minims of adrenalin usually control the situation promptly. Rarely a case will not respond. During the past year we have given these patients neosynephrin with very prompt response. In psychic shock the decrease in the effective circulating volume of blood is apparently brought about, for the most part, by greatly increased vascular capacity. It seems that the vasoconstrictor center is inhibited or the vasodilators stimulated. However, this type of nervous shock is of brief duration.

Concerning the circulatory system, vascular tension is a very important factor with all types of anesthesia and should be maintained within certain limits. All patients show some variations in their blood pressure while under anesthesia and this is true of the peridural type. In a few cases there was a temporary rise which we interpreted as a psychic stimulation of the patient's own adrenals. We have found that 25 per cent of patients will show a drop of several points in blood pressure, about 10 per cent, to a level at which adrenalin is indicated, and in 1 per cent a state of severe shock may result. In 75 per cent of the cases the blood pressure is affected so mildly that we no longer consider it care-

fully, except in those cases in which the respiration becomes shallow and the pulse quite small. The pulse rate remains within normal in all cases that are without psychic reactions, while the quality of the pulse varies with the blood pressure.

SERIOUS REACTIONS

We have experienced but few serious reactions. In six patients the blood pressure dropped to a point at which no reading was possible, but the heart continued at a rate of 50 to 60; there was a temporary suspension of respiration after it had receded to five or six per minute. In each of these cases artificial stimulation of respiration and the use of adrenalin restored a normal condition in from five to fifteen minutes. In two patients, after several minutes, we abandoned operation; one of these patients suffering from a gunshot wound of the abdomen, had been refused operation a few hours before because of shock. The other, a negro, aged 34, with an inguinal hernia, demonstrated what we interpreted as a drug idiosyncrasy. He was given adrenalin, and artificial respiration was administered for about twenty minutes. He was operated upon the following day under general anesthesia with satisfactory results

Three cases in which obverse reactions occurred in spinal anesthesia after an injection of 5 cc. were: a 68 year old man, with chronic cholelithiasis and several large stones in the common duct, another, a man of 66 years, with a similar gallbladder condition, and the third, a woman, aged 38, with chronic cholecystitis. In each it was found that a mistake had been made in the location of the needle and after the regulation five minutes the patient was unable to move the feet, and a needle prick in the buttocks demonstrated loss of sensation. Each was operated upon under a very satisfactory spinal anesthesia with an uneventful recovery.

No operator can hope to be 100 per cent perfect in placing the needle in the peridural space; however, with the careful technic described, the hazards of this type

of anesthesia are reduced almost to the vanishing point.

What were apparent failures in our early work we later found were due to our inexperience, the use of a 1 per cent solution, and not allowing sufficient time for anesthesia to develop. We now know that when the solution is properly placed and a 2 per cent solution used, anesthesia will be obtained in every case. Occasionally a longer time than fifteen minutes will be required before anesthesia is complete. Every failure to obtain anesthesia of some degree has been found to be due to an error in technic.

CONTRAINDICATIONS

We have intentionally avoided the very bad risk cases. Experience has revealed that it is unwise to use this type of anesthesia in severe sepsis, prolonged toxemias, especially intestinal obstruction of long standing, stomach cases with dehydration and inanition. We have not had the temerity to use it in marked hypotension. While we do not believe that hypertension is in any sense a contraindication, we have seen a few cases of hypertension in which the pressure was elevated several points while under the influence of peridural anesthesia. The experienced operator is the best judge of how a given case will respond to an anesthetic, and it is his responsibility to have administered the anesthetic best adapted to the patient.

POSTOPERATIVE COURSE

The patient is returned to his bed, placed in a normal, comfortable position and given water immediately. At times water is given before the patient leaves the operating room. A generous diet may be allowed early, for there is an entire absence of nausea and vomiting. There is no headache or backache, and wound pain is reduced to a minimum. It is rare to encounter urinary retention. Recovery is more comfortable than with any other type of anesthesia known to the authors, with the possible exception of local. Spinal cord injury, bulbar paralysis and puncture of the nucleus pulposus should not occur in peridural anesthesia. The central nervous system cannot be affected when the solution is placed in the peridural space, as all the anesthetic effects take place in the peripheral nerves.

COMMENT

The 1000 patients operated upon under peridural anesthesia cover practically the entire range of surgical operations below the clavicle. To date we have had no fatalities from the anesthetic. The relative simplicity and the wide margin of safety in the hands of the average operator should encourage more general use of peridural anesthesia.

SUMMARY

1. This report is based on the use of peridural anesthesia in 1000 personally supervised cases.

2. The current literature contains reports of its use in several thousands, with but two deaths and a few serious reactions recorded.

3. The absence of postoperative complications shortens the hospital stay and hastens convalescence.

4. The minimum cost, the few instruments required, and the ability to carry on without a trained anesthetist have an economic value, especially in small hospitals and in rural districts.

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Correction: In "Operations Fifty Years Ago," by R. Matas, which appeared in the January issue of the Journal, 51: 47, column 1, lines 19–23, the word *head* should be substituted for *hand*. The words of Guerin to the Pope should read, "I shall be very careful, your Holiness, when I return to France, to let no one know that my head has rested on your breast, for if I did, they would soon cut off my ears to make relics of them."

A MODIFIED PORRO OPERATION*

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DURING the past few years, many articles have appeared in the literature concerning the Porro cesarean section, which is a cesarean section followed by a suprapubic hysterectomy. This procedure has considerably lessened maternal mortality, particularly in those disasterous cases of sepsis and hemorrhage.

For the past ten years, it has been our custom, when the occasion arose, to alter the above mentioned procedure by removing the uterus with the enclosed fetus. This departure from the accepted Porro cesarean appears to us to have many advantages. The most important are the lack of spill from the incised uterus in cases of infection and the minimum blood loss, particularly when profuse bleeding occurs. It should be the operation of choice by the trained operative obstetrician and we believe, when it is better understood, will be resorted to in preference to the present Porro cesarean.

In this paper, it is our purpose to review very briefly the early history of the Porro cesarean operation, to describe the operation as we do it and to report the results obtained in 233 cases.

Cesarean section followed by supravaginal hysterectomy has been practised for many years. Cavallini, in 1768, suggested this operation, and it was performed successfully on rabbits in 1823. Storer, of Boston, did it in 1869 for fibroids but not with success. In 1877, Porro advised the amputation of the body of the uterus and adnexa above an elastic ligature placed about the cervix, and the stump was then secured in the abdominal wall. For a succeeding number of years, isolated cases were reported with various modifications of the original procedure.

In order to study better the original procedure and its modifications, Harris of Pittsburgh, years ago, suggested the following classifications:

1. *True Porro Cesarean Section* in which the cesarean was done as a first stage and the stump of the cervix secured in the abdominal wall.

2. *Modified Porro Cesarean Section* similar to the above operation with the pedicle dropped back into the abdomen.

3. *Porro Mueller Operation* during which the uterus was eventrated, a wire constrictor placed around the cervix, the uterus opened, the contents removed and the stump secured as in the original Porro.

4. *Modified Porro Mueller Operation* with the pedicle dropped back into the abdomen.

In 1890, Dr. J. F. Baldwin, of Columbus, Ohio, was the first to perform this operation in Ohio and the ninth in this country. Dr. L. E. Pfaneuf, of Boston, Massachusetts, in 1931, reported twenty-five cases without a maternal death.

DeCourcy, in 1930, described a bloodless modification in which, contrary to the original Porro or the Porro Mueller operation, the blood supply to the uterus is cut off *before* making the uterine incision and the gestation sac is delivered intact.

The procedure we wish to describe is somewhat similar to that of DeCourcy, in that the blood supply to the uterus is ligated *before* delivery of the baby. However, it differs in that the uterus is not opened until it is removed from the abdomen and then by an assistant at another table the baby is delivered.

This operation is simple in technic, quickly performed, less sloppy and less dangerous than the cesarean section followed by hysterectomy, because it lessens loss of blood, causes little shock and prevents gross contamination of the peritoneal cavity when infectious material is present.

A study of the hemoglobin, blood count and blood pressure is always made before the operation and transfusions freely given when indicated.

assistant pushes the intestines out of the way and protects them by means of large hot packs. A large curved DeLee retractor is held in place at the lower angle of the
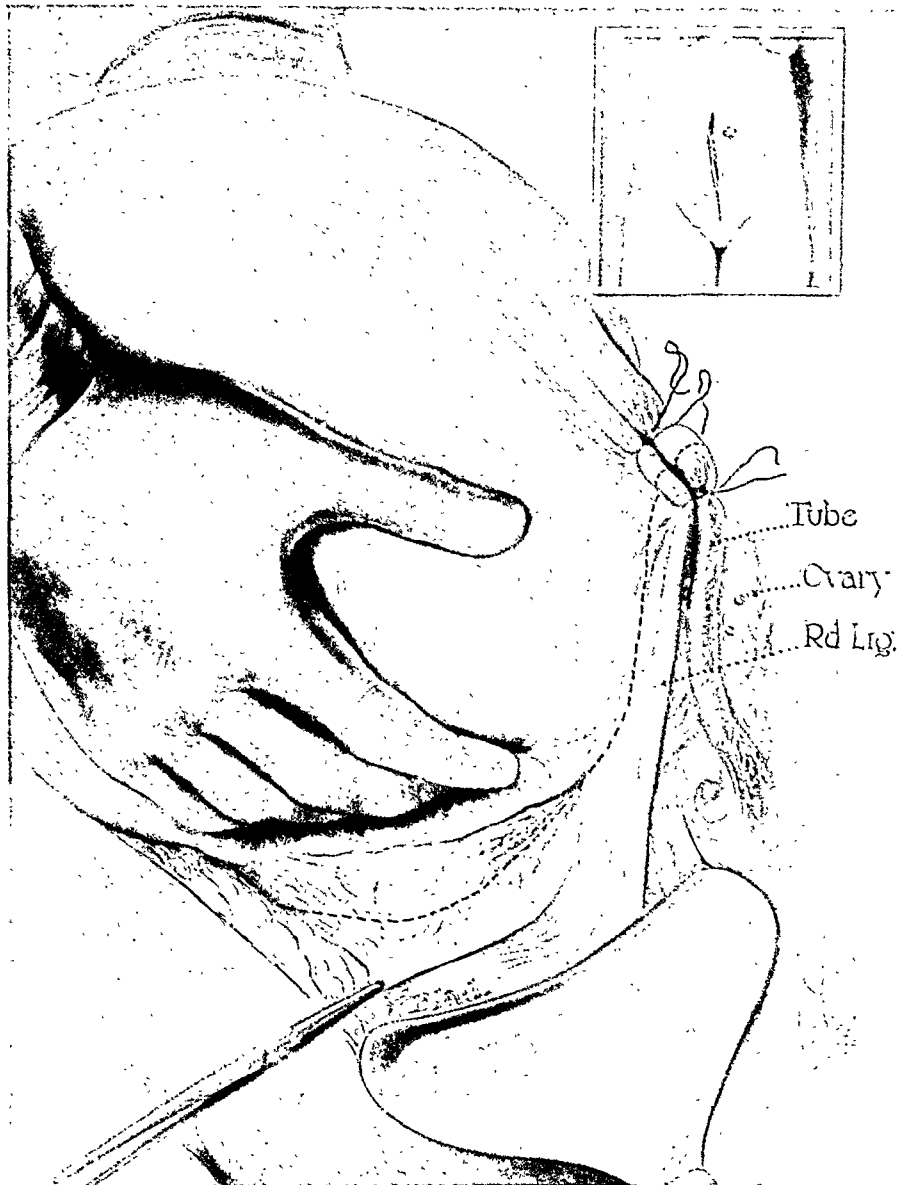
Fig. 1. Ligation of the large veins lateral to the round ligament.

After the bladder has been emptied and a long midline incision has been carried well down toward the symphysis, the abdomen is opened. The bleeding is controlled in the fascia by ligatures and then the peritoneum is opened. At this time, the head of the operating table is lowered and the abdomen is carefully explored for adhesions of the intestine and omentum to the body of the uterus. If present, these are freed and the operator then lifts the uterus up through the abdominal opening and his

incision so that the operator has a clear view of the anterior surface of the lower uterine segment.

The head of the fetus is lifted up out of the lower uterine segment and the entire uterus is held up by the assistant. With the head of the fetus still dislodged from the lower uterine segment, the operator ligates the large veins lateral to each round ligament, which he also includes if possible in his ligature. This suture is anchored to the round ligament to prevent slipping and also

acts as a lateral boundary beyond which the operator does not pass. (Fig. 1.)

The assistant, at this time, still has the

The uterine arteries are ligated and all other vessels, the cervix and surrounding incised tissue are sutered with continuous
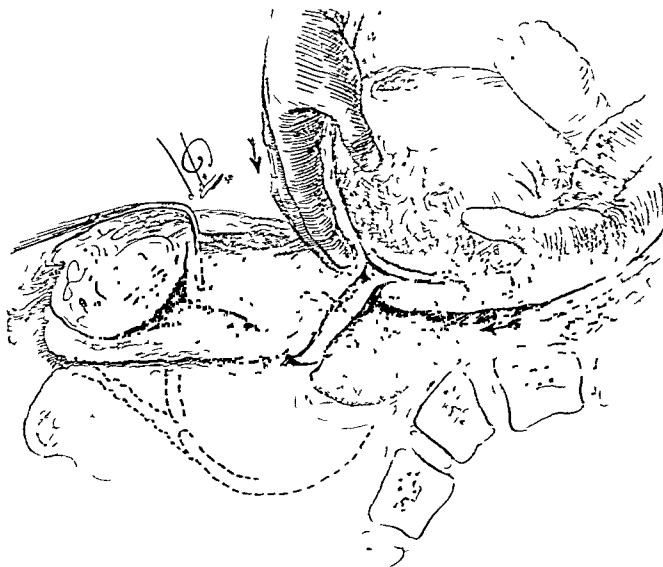
FIG. 2. Approximation of the anterior and posterior walls of the lower uterine segment.

fetal head dislodged and while holding up the uterus, he approximates by pressure of his fingers the anterior and posterior walls of the lower uterine segment in order to facilitate the placing of the curved Kelly clamps. (Fig. 2.) The peritoneal bladder fold is dissected down and the uterus is amputated. (Fig. 3.)

We have found by taking smaller bites with our clamps there is less chance of their slipping and the Kocher clamps are much to be preferred in the vicinity of the cervix.

After the uterus is freed, it is handed to an assistant who at a side table, incises it, removes the child and cuts the cord. (Fig. 4.)

As a general rule approximately fifteen minutes elapse from the time the uterine blood supply is cut off until the child is removed from the uterus.

The fact that we can deliver live babies (if we have viable ones at the start of the operation) after the blood supply has been stopped for such a length of time, astounds our visitors. However, it is just another demonstration that undue haste in operative obstetrics is not always necessary in order to obtain live babies.

chromic No. 2 catgut. A gauze drain can be inserted in the cervix if desired.

The round ligaments are anchored to the cervical stump and the stump peritonealized by anchoring the peritoneal bladder fold to the posterior aspect of the cervical stump. (Fig. 5.) The abdominal incision is then closed with chromic No. 2 catgut throughout and through-and-through retaining silkworm when necessary.

We always attempt to save one or both ovaries when possible and ordinarily there is enough endometrial tissue left in the stump so that the patient has some bloody showing each month. This occurrence seems to have a good psychic effect on the patient and is desirable.

We have also had the unexplainable experience of removing both ovaries in this type of operation and still have the patient report occasional bloody showing with no appreciable gain in weight and no menopausal symptoms.

We have learned from experience, when this operation is done for extreme bleeding from a centrally implanted placenta praevia, that it is advisable to explore thoroughly the cervical stump from above and

below, for very often a piece of placenta may be left in the cervix. One such incident occurred in this series and it was not dis-

obstetrician's armamentarium even though the occasion for its use is rare.

This operation has a definite place in the

FIG. 3. Amputation of uterus after peritoneal bladder fold has been dissected from the lower uterine segment.
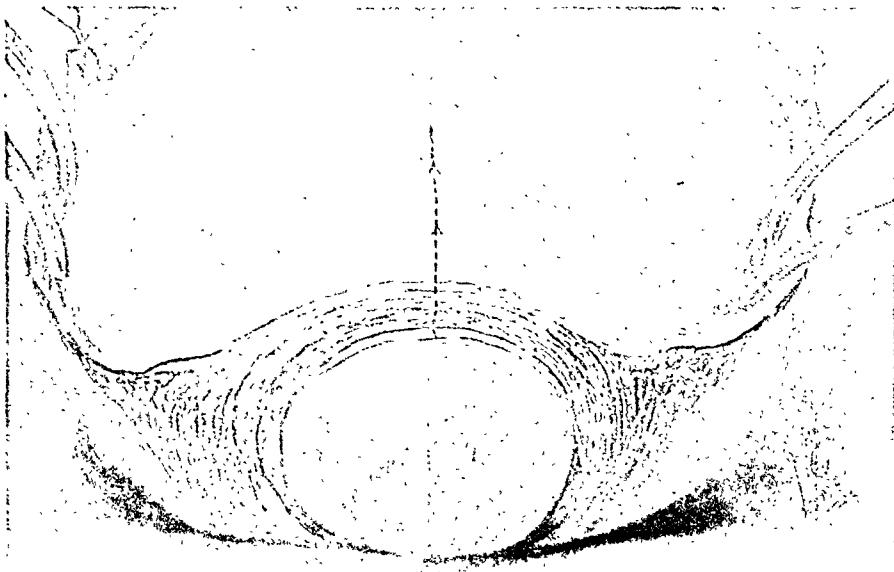
FIG. 4. Incision of uterus and removal of fetus.

covered until the patient was practically exsanguinated on the fourth postoperative day. The portion of placenta was removed and the cervical stump packed from below. The patient was given blood transfusions immediately and fortunately recovered.

We believe this is a life saving procedure and should be a part of every trained

treatment of frankly infected undelivered women. It also has a place in the treatment of those occasional patients, who are brought into the hospital shocked and practically exsanguinated; and we have found from experience after these patients are treated for shock and receive blood transfusions and when the lower uterine

segment is not effaced or the external os dilated, they do very much better with this type of procedure than they do with a

perform this operation more frequently. It is difficult to believe, but it is a clinical fact, that these patients are noticeably less
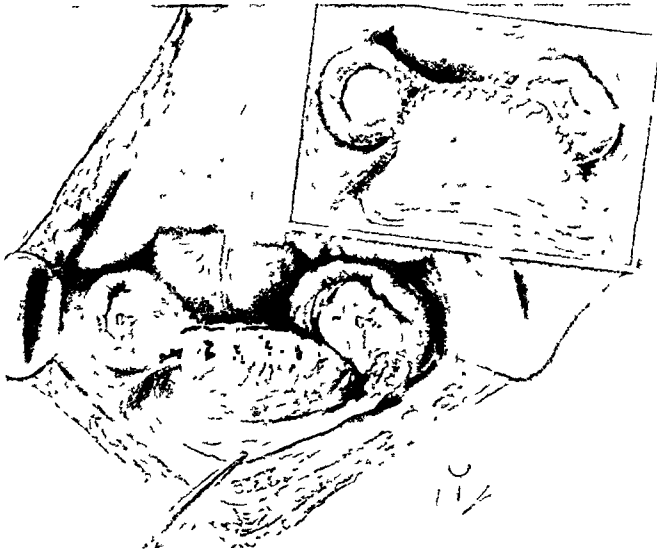
FIG. 5. Anchoring round ligaments to cervical stump, closure of cervical stump

cesarean section followed by a hysterectomy. Our experience with both types of operation has been rather extensive and the lack of shock in the operation as described is most noticeable.

As our technic improved with this operation it was natural that our indications broadened and for some of these indications we may be criticized. However, our decisions rested upon the study of each individual case and we felt justified in what we did at the time.

The indications for the majority of the cases reported herein were as follows: (1) Fibroids with or without degeneration; (2) sepsis; (3) ablatio placentae with uncontrollable hemorrhage; (4) placenta praevia with uncontrollable hemorrhage; (5) partly ruptured uteri; and (6) completely ruptured uteri.

While the majority of obstetricians at the present date would prefer doing a cesarean followed by a possible hysterectomy for some of the indications mentioned above, we are confident that as their experience grows with this procedure and they see the lessened degree of shock as compared with other procedures, they will

shocked and recuperate faster with this procedure than do those who have had a simple, classical cesarean section.

Recently Waters has revived interest in extra peritoneal cesarean section for the frankly infected case. We heartily endorse this procedure for those occasional infected cases, particularly in primiparae, who have normal uteri; but many times we see frank infection particularly in multiparae exhibiting additional complications such as fibrotic uteri or severe hemorrhage, and any type of cesarean in those cases, in our experience, is contraindicated because they are bad risks postoperatively. We prefer to sacrifice the uterus and the future function of childbirth in that type of case rather than the mother.

The total number of cases in this series was 233; fourteen mothers died. The causes of death were as follows after postmortem examinations were made: (1) Uremia and abscess of the lung; (2) placenta praevia (two cases); (3) hydronephrosis with kidney destruction; (4) embolism (three cases; death was sudden after patient was convalescing satisfactorily); (5) cardiac decompensation (two cases); (6) detached

placenta with severe hemorrhage and shock (two cases); (7) fibroids complicated by bowel obstruction caused from an old hernia from a previous appendectomy; (6) paralytic ileus; and (9) peritonitis following evisceration of the bowel through a broken down incision on the fifth day.

The total number of dead babies was fifty-three. Of this number twenty-six were nonviable, eighteen were known to be dead and nine died within one week.

CONCLUSION

1. A description of a modified Porro operation is given.

2. The indication for this procedure many times is not the safe delivery of a live child but the saving of a mother's life.

3. It is our belief that this operation has a very definite place in operative obstetrics in infected, undelivered cases of pregnancy, because of the absence of spill from the uterus and the minimum blood loss.

4. This procedure also has a place in the management of uncontrollable bleeding cases.

5. Lack of shock is one of the important points of this operation.

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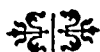
UMBILICAL HERNIA*

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APPROXIMATELY eighty thousand hospital admissions were recorded at the University Hospital during the last eighteen years. During this period sixty-two umbilical hernias were encountered. Of these sixty-two, seven were present at birth as a herniation into the cord structures, twenty-two were noted soon after birth and thirty-three were of the adult type. Umbilical hernia in each of the three age groups will be considered.

The case records of the seven newborn with a congenital umbilical hernia excited further interest. An additional eighty-four cases, reported in the literature during the last forty years, were reviewed. The data presented in these ninety-one cases were studied.

Hernia into the umbilical cord, known also as exomphalos or congenital umbilical hernia, may be either of an embryonic or fetal origin. Congenital umbilical hernia of an embryonic origin is not a true hernia. Organ contents of the umbilical sac usually regress into the abdominal cavity near the end of the third month of intra-uterine life. Subsequently, the anlage of the umbilicus is formed. Rarely the umbilical sac contents partially or completely fail to regress into the abdominal cavity but remain and develop in the cord anlage. Consequently, at birth there is a congenital umbilical hernia of an embryonic origin. With an early arrest of development the defect may extend from the symphysis to the manubrium; and even if the newborn is viable, the extent of the malformation and frequent associated abnormalities, preclude the possibility of surgical cure. Three cases of this extensive maldevelopment were recorded. The fetal congenital umbilical hernia is a true herniation of the abdominal

contents and develops after the third month of intra-uterine existence. It consists of an actual protrusion of organs after normal regression into the abdominal cavity. Most of the reported cases of congenital umbilical hernia were of embryonic origin while a few were probably of fetal origin.

TABLE I

INCIDENCE OF CONGENITAL UMBILICAL HERNIA

Author, Institution	Years	Hospital Admissions	Deliveries	Cong. Umb. Delivered in Hospital	Hernia Admitted with Pathology
University Hospital	1922–40	80,000	5,197	2	5
Hebert, A. F. ?	?	?	56,385	20	
Lindfors, Munich Mat ..	1862–81	?	5,184	1	
Balantyne ?	?	?	5,000	1	
Watson ?	?	?	5,000	1	
Block Berlin Charite	?	?	5,000	1	
Vienne Paris Charite	?	?	3,043	0	

Table I indicates the incidence of this type of hernia at the University Hospital and other institutions.

The pathology was encountered in twice as many males as females and occurred equally among the newborn of primipara and multipara. In only three instances, abnormalities were recorded in the other children. Four histories listed complications during pregnancy. Lues was not considered a factor, however, Paucot reports the condition in three successive fetuses delivered of a luetic mother.

Table II indicates the incidence of the various types of concomitant abnormalities. More than one congenital defect was present in approximately one-third of the cases.

Large hernial sacs may rupture during the course of the delivery. Four cases were found in which this had occurred. Two

* Read before the meeting of the Oklahoma City Clinical Society, November 1, 1939.

patients were operated upon with one death; two were treated conservatively and both expired. The presence of a congenital

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TABLE II

VARIOUS MALFORMATIONS RECORDED IN NINETY-ONE CASES OF CONGENITAL UMBILICAL HERNIA

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Malformations   No. of Cases

Malformation	No. of Cases
Meckel's Diverticulum	6
Multiple and extensive	3
Anencephaly	2
Atresia of descending colon	2
Spina bifida	2
Nonrotation of large intestine	1
Epispadias	1
Absence of common bile duct	1
Macroglossia	1
Cleft palate	1
Hare lip	1
Patent omphaloenteric duct	1
Mongoloid	1
Imperforate anus	1
Stenosis of colon	1
Microcephaly	1
Hydramnion	1
Absence of the tibia, left	1
Absence of right radius and ulna	1

hernia was not noted at delivery in three infants, the cord was ligated incarcerating

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TABLE III

STRUCTURES FOUND TO OCCUPY THE SAC

</div>

                           No. of Cases

A. Multiple organs

Structure	No. of Cases
Small and large intestine	13
Liver and small intestine	9
Small and large intestine, cecum, appendix	7
Ileum, cecum and appendix	5
Small intestine, Meckel's diverticulum	4
Liver, small and large intestine	4
Small intestine, Meckel's diverticulum, cecum, appendix	4
Liver, small and large intestine, appendix	2
Stomach, liver, intestine and spleen	1
Cecum and appendix	1
Liver and gallbladder	1
Heart and abdominal contents	1
Liver, spleen, small and large intestine	1
Liver, stomach and small intestine	1
Liver, stomach, small and large intestine	1
Gallbladder, small and large intestine	1
Abdominal contents	3
Total	**59**

B. Single organs

Structure	No. of Cases
Small intestine	21
Liver	9
Meckel's diverticulum	2
Total	**32**

a loop of ileum in one and a Meckel's diverticulum in two. Obstruction super-

vened in the former with a fatal termination while the latter developed a fecal fistula which later was closed successfully.

The hernial wall is composed of two avascular layers separated by a variable quantity of Wharton's jelly. The external layer merges with approximately one-half inch collar of skin at the base of the tumor. The internal layer is continuous with the peritoneum.

Several organs may occupy the sac. (Table IIIA.) In about one-third of the cases the sac contained only one structure. (Table IIIB.)

The prognosis is influenced by several factors: the diameter of the defect, the size of the hernia and the elapsed delay before the intervention.

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TABLE IV

DIAMETER OF THE NECK OF THE SAC IN RECORDED INSTANCES

</div>

                     No. of Cases

Diameter	No. of Cases
Less than 5 cm	52
More than 5 cm	26

In most instances the diameter of the neck of the sac is less than 5 cm., however, a considerable number present a large defect. (Table IV.) It was interesting to note that in six recorded cases the defect extended from the symphysis to the pubis and four survived surgical repair. If the patient is seen early, a rather large defect must not influence the surgeon to forego operative procedure. The hernial defect must be closed early and preferably within the first six hours. (Table V.)

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TABLE V

MORTALITY IN RELATION TO THE DELAY BEFORE SURGERY

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Delay	Patients Operated Upon	Patients Expired	Percentage Mortality
To 12 hrs	56	12	21.4
12 to 24 hrs	9	4	44.4
After 24 hrs	13	8	61.6

After twelve hours of delay the mortality increases rather markedly. The increase in mortality incurred with the delay of sur-

gery resembles that found in cases of ruptured peptic ulcers. Resection of bowel or incomplete closure of the defect usually results in a mortality. Two patients expired following bowel resection, three following resection of a Meckel's diverticulum and two of three following incomplete closure in which the liver was sutured into the wound. Of the nine patients treated conservatively, only one survived. In patients subjected to delayed surgery or treated conservatively, peritonitis is the most common cause of the fatal issue. One may safely conclude that surgical repair should be attempted in practically any instance, particularly if the patient is seen early and there is the slightest possibility that the defect may be closed.

In two of seventy-eight operations the hernia was repaired by the extraperitoneal method. This procedure may be used when the hernia is quite small. The amnion and Wharton's jelly are removed from the underlying peritoneum, the sac manually inverted and the anatomical layers are closed in turn. In one of the reported cases it was stated that the operator reduced the contents of the sac by twisting the cord and by ligation at the base. Any of the possible contents of these hernia may be incarcerated by such procedure.

In seventy-six cases the intraperitoneal method was used. An elliptical incision is made in the skin surrounding the base of the tumor. After ligation of the cord vessels, the peritoneal cavity is entered inferiorly. By careful dissection the sac structures are removed with the cuff of skin at the base. The hernial contents are reduced and the wound is closed in layers. Occasionally the peritoneal portion of the sac is densely adherent to the liver. No attempt should be made to remove it because of the danger of a profuse hemorrhage. The adherent portion may be returned to the peritoneal cavity. No other surgery should be attempted if it can be avoided, such as the removal of the appendix or a Meckel's diverticulum. In cases in which the liver had occupied the

sac and was irreducible, after enlarging the original incision, it has been sutured to the wound edges and partially exteriorized. One of three patients survived this procedure. In some instances effective reduction can be maintained and the wound brought into apposition only by the use of through-and-through sutures.

Twenty-two of the sixty-two umbilical hernias were of the infantile type. All histories indicated that they were noted during the first or second month of life. Fourteen were of the male and eight were of the female sex. Other evidences of maldevelopment were infrequently seen. One infant presented a cleft palate and another an enlarged thymus. In the presence of an umbilical hernia a careful check of the inguinal regions should be made, for six of the twenty-two patients had bilateral inguinal hernia.

In most instances the protrusion is through the superior quadrant of the umbilical aperture since at this point the umbilical vein enters the falciform ligament. The fascial defect is usually of 1 to 2 cm. in diameter; it was not larger in any of these cases. Usually the sac is empty except during crying or straining of the infant.

Umbilical hernia of an infantile origin is responsive to mechanical treatment in children under five years of age. Treatment should be instituted as soon as the hernia develops. If effectively maintained, a cure may be expected within a few months. At this early stage it is recommended that the truss support be used for at least six months. If treatment is not instituted until after the first year, the mechanical support should be applied continuously for a year or longer. Some few cases in this group, however, will not respond.

If the defect persists or increases in size after a thorough trial of the mechanical treatment, an operation is justified. Unless otherwise indicated surgery is not advisable before five years of age. The technic of the repair does not differ from that used in the adult, consisting of eradication of the sac, apposition of the recti muscles and trans-

verse overlapping of the fascia. If the blood supply seems adequate, the umbilicus may be preserved by placing the curved incision an inch or so inferior to the fascial defect.

Twenty of the thirty-three adults recalled the onset of an umbilical hernia between the ages of twenty and thirty; however, many presented themselves at a later date for operation. (Table vi.)

TABLE VI
AGE AT TIME OF SURGERY

Age	No.
21–31	7
31–41	9
41–51	9
51–61	5
61–71	3

The sex and race distribution is indicated in Table vii.

TABLE VII
SEX AND RACE INCIDENCE

Sex	No.	Race	No.
Males	8	White	29
Females	25	Negro	3
		Indian	1

Undue exercise, falls, direct injuries, suppuration at the umbilicus or rapid loss of weight may be occasional etiological factors. Obesity and multiple pregnancies seem to have a greater influence. (Table viii.)

TABLE VIII
POSSIBLE ETIOLOGICAL FACTORS

Factors	Incidence
Multiple pregnancies	19 of 25 females
Obesity	25 of 33 cases

Thirty-three adult patients were submitted to surgery. In most instances the defect was of less than one inch in diameter and no defect was found larger than three inches. As with the infantile hernia the defect was at the point of the obliterated umbilical vein in the umbilical cicatrix. Diastasis recti was the rather common finding in the female. The hernial coverings consist of the peritoneal sac, transversalis fascia and skin. Structures encountered in the sac are listed in Table ix.

Strangulation is not an uncommon complication in the adult. Four of the thirty-three surgical cases presented strangulation of the sac contents. About one of every eight umbilical hernias will strangulate. In two instances intestinal resection was necessary. Simple release of adhesions sufficed in the other two cases.

TABLE IX
SAC STRUCTURES

Structures	No. of Cases
Adherent omentum	17
Adherent small bowel and omentum	7
Adherent colon and omentum	2
No structures in the sac	17

There were no deaths among the twenty-nine adult surgical cases. Of the four additional cases with strangulation, two patients expired. The operation of simple umbilical hernia is usually considered to present a mortality of from 1 to 3 per cent. With strangulation this mortality will vary between 30 and 50 per cent.

These cases have not been checked regarding the percentage of recurrence. Transverse overlap of fascia is followed by a recurrence rate of about 10 per cent while that of other methods may be as high as 20 per cent.

Preliminary preparation of the patient contributes to the success of surgery. Adequate weight reduction can not be over-emphasized. The obese patient must be placed on a low caloric diet with thyroid administration if the basal rate is below normal. An anemia is corrected, the cardiac status carefully evaluated and the renal function thoroughly checked. In instances of voluminous hernias the use of the abdominal binder for a period of time is advisable.

Unless concomitant pelvic surgery is indicated the transverse overlap of the fascia is conceded to be the best type of repair. The hernial protrusion is enclosed by a transverse ellipitical incision; the underlying fascia is exposed by dissection of the fat to the neck of the sac at all points. The sac is entered at a suitable point at the neck. Any adherent omentum is freely ligated and divided but not dissected. An adherent bowel is either carefully dissected free or returned to the

abdomen with portions of the sac. After the peritoneum is closed, the recti muscles are brought into apposition, if possible. The authors prefer the use of continuous chromic catgut for the peritoneum and interrupted chromic catgut for the muscles. The fascial flaps are overlapped transversely by interrupted chromic mattress sutures. The subcutaneous tissue is closed to eliminate dead space and a small soft rubber drain at this point is advisable. Meticulous hemostasis insures no postoperative hemorrhage.

Should any indication of postoperative distention develop, the Levine nasal tube with continuous gastric suction must be employed. A low Fowler position and frequent turning of the patient allays pulmonary complications. Adequate intravenous glucose and subcutaneous saline are administered to insure an output of 1,200 to 1,500 cc. of urine per twenty-four hours. It is essential that the patient remain in bed at least three weeks and wear an elastic belt for a year or longer. Undue weight gain must be avoided.

SUMMARY

One case of congenital umbilical hernia may be encountered in every five thousand deliveries. One third of the cases of congenital umbilical hernia will have more than one congenital defect. Careful inspection of the cord will preclude the ligation of a loop of intestine in a small congenital hernia. The hernial defect must be closed early and preferably within the first six hours.

An inguinal hernia will be present in about 30 per cent of the infants with an infantile umbilical hernia. As a rule surgery should not be instituted for an infantile umbilical hernia before five years of age.

Strangulation occurs in one of every eight umbilical hernias of the adult type. A mortality of 1 to 3 per cent for surgical repair of the umbilical hernia is increased to 30 to 50 per cent in the presence of strangulation. Adequate weight reduction is important and voluminous hernias should be subjected to an abdominal binder for a period of time. The surgical repair is best accomplished by the Mayo transverse fascial overlap.

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A FOLLOW-UP OF HERNIA REPAIR IN MENTALLY SICK AND MENTALLY DEFICIENT PATIENTS*

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REPORTS of the results of the operative treatment of hernia from general hospitals and surgical clinics are frequently seen in the surgical journals; however, the hernia problem in mentally sick and mentally deficient patients, although known to many surgeons, has not been summarized in the literature very extensively, nor have the problems encountered in this group of patients been given due attention. Some writers[1][2] have stressed the psychiatric complications in surgical problems and the value of the psychiatrist in relation to surgery but very little attention has been given to the problem from the standpoint of the actual handling of psychiatric cases by the surgeon. It is our purpose in this paper to summarize our experience at the Metropolitan State Hospital with fifty patients suffering from hernia who were treated by surgical measures.

STATISTICS

The series included thirty-one committed psychotic patients and nineteen mentally defective patients from the Walter E. Fernald State School. Psychiatric diagnoses are classified in Table I. There were forty-six males, twenty-nine from the Metropolitan State Hospital and seventeen from the Walter E. Fernald State School, and four females, two from the Metropolitan State Hospital and two from the Walter E. Fernald State School.

Age of Patients. These varied in age from the age of sixteen to sixty-five plus. (Table II.) One notes that the Walter E. Fernald State School patients were all below the age of forty-five at the time of operation and that the majority of the Metropolitan State Hospital patients were above that age group. As the greatest percentage of recurrences occurred in the Metropolitan State Hospital patients this one factor lends itself to some comparative analysis. In a rather large series of adult normal patients reported by Longacre[4] in the indirect group 65 per cent of the patients were under thirty-five years of age and only 26 per cent were over forty-five, while 51 per cent of the patients with direct inguinal hernias were under thirty-five years, while 46 per cent were over thirty-five. In our group, 22 per cent of indirect inguinal hernias were under thirty-five, while 78 per cent were over thirty-five. In the direct inguinal hernias, 34 per cent were under thirty-five and 66 per cent over thirty-five.

Type of Hernia. For hernias classified as to type see Table III. Twelve patients (Metropolitan State Hospital, eight; Walter E. Fernald State School, four) had bilateral inguinal hernias. As can be noted from the table sixty-eight, or 93 per cent, of hernias were of the inguinal type, of which thirty-two, or 47 per cent, were direct inguinal hernias. The large proportion of the direct inguinal hernias occurring

in the younger age group of the Walter E. Fernald State School patients is to be noted. According to Watson[5] direct inguinal hernia is infrequent, constituting only about 5 to 7 per cent of all inguinal hernias. It is stated that more recent views

TABLE I

Diagnosis	Number of Cases
Schizophrenia	15
Alcoholic psychosis	4
Psychosis with mental deficiency	4
Manic-depressive psychosis	3
General paralysis	1
Traumatic psychosis	1
Psychosis with cerebral arteriosclerosis	1
Paranoid condition	1
Involutional psychosis	1
Mental deficiency (W.E.F.S.S.)	
Imbeciles	11
Morons	7
Borderline	1

indicate that the percentage of direct inguinal hernias may be as high as 25 to 30 per cent.[6] A consideration of the condition of the muscles and fascia in a large proportion of these cases will be made below. Of this group five patients, or .7 per cent, were incarcerated. The recurrent inguinal hernias were difficult to diagnose at times but the majority were of the direct type. Figure 1 illustrates the usual size and type of hernia encountered.

TABLE II

Age Groups	Number of Cases	
	M.S.H.	WEFSS
65+	2	0
60–65	3	0
55–60	9	0
50–55	5	0
45–50	3	0
40–45	2	4
35–40	4	3
30–35	2	1
25–30	1	4
20–25	0	3
15–20	0	4

Type of Operation. These patients were all treated by surgical measures, which will

be described below. There were no deaths as a result of the operation. One operation could not be completed because of the

FIG. 1. Usual size and type of hernia.

patient's poor condition incident to poor response to anesthesia. One patient died several months later of pulmonary tuberculosis but did not have a recurrence of his hernia at time of death. Another patient died and, although there was no recurrence shortly after the operation, a satisfactory follow-up was impossible.

TABLE III

	M.S.H.	WEFSS
Indirect inguinal		
Right	9	2
Left	6	1
Direct inguinal		
Right	9	10
Left	8	5
Recurrent inguinal	11	7
Postoperative	2	1
Umbilical	1	0
Omental	0	1

Due to the fact that most of the hernias were inguinal (all except five) the end results will be considered only in this group. There was a total of sixty-eight operations, two of which were not completed. Three different types of surgical procedure were used as follows: (1) The regular (Bassini

modified)* operation was performed on twenty-two Metropolitan State Hospital patients and on ten Walter E. Fernald State School patients. (2) The regular operation plus the use of commercial fascia lata strips was performed on twelve Metropolitan State Hospital patients and on five Walter E. Fernald State School patients. (3) The regular operation plus patient's own fascia lata strips was performed on seven Metropolitan State Hospital patients and on ten Walter E. Fernald State School patients.

The Bassini operation[3] was performed except that after excision of the sac the stump was transfixed to the transversalis muscle. In the cases in which fascia lata was used the Bassini operation was performed, and the fascia lata was used as sutures by weaving back and forth to form a sort of lattice work to approximate the muscles to Poupart's ligament.

Results of Operation. In the regular operative group there was no recurrence in fifteen patients or 46 per cent. These cases were re-examined after operation as follows: four years, seven; three years, three; two years, three; one year, two.

In the commercial fascia lata group, there was no recurrence in fourteen patients, or 72 per cent. These cases were re-examined after operation as follows: two years, six; eighteen months, five; one year, three.

In the group in which the patients' own fascia lata were used in the repair, there was no recurrence in twelve, or 64 per cent. These cases were re-examined after operation as follows: four years, four; three and

one-half years, five; three years, one; two and one-half years, two. In this group of cases the best results were obtained in the commercial fascia lata group. One has to evaluate these figures with care in view of the fact that the cases were not followed for as long a period of time as those in the other groups.

In summary there was no recurrence in the entire group of patients in forty-two instances, or 61.7 per cent. The greatest percentage of recurrences occurred in the Metropolitan State Hospital cases, as can be surmised from the following figures. Metropolitan State Hospital—no recurrence, nineteen (67.86 per cent), Walter E. Fernald State School, fifteen (88.24 per cent), average of total, 75.6 per cent. Recurrence—Metropolitan State Hospital nine (32.14 per cent), Walter E. Fernald State School two (11.76 per cent), average of total, 24.4 per cent.

Recurrence of hernias occurred in the indirect inguinal group in five instances, in the direct inguinal group in four instances and in the recurrent inguinal group in twelve instances. We were unable to complete the operation in one case (two hernias); one patient died. Of the indirect inguinal group, one case recurred in a few days, one in a period six to twelve months, two in a period between twelve to eighteen months, and one in a time interval between eighteen to twenty-four months. In four instances the regular type of operation was used and in one instance the commercial fascia lata operation was used.

Of the direct inguinal group, one case recurred in fifty-six months, one in twenty-eight months, one in two months and in one case the exact time of recurrence was unknown. The types of operation used were: regular operation, 1; commercial fascia lata, 1; patient's own fascia lata, 2.

Of the recurrent inguinal hernia group seven cases recurred in less than three months, three in six to twelve months, one in sixty months and in one case time of recurrence was unknown. Types of operation used: regular operation, seven; com-

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* (a) Incision 2 cm. above and parallel with the inner half of Poupart's ligament, the skin being divided for a distance of about 10 cm.; (b) splitting of the fibers of the external oblique, from the external ring to a point slightly above the inguinal ring; (c) liberation and opening of the sac, with reduction of the contents; (d) removal of the sac flush with the peritoneum, after transfixation and ligation of the neck; (e) suture of the internal oblique and transversalis muscle to the shelving portion of the inguinal (Poupart's) ligament, underneath the spermatic cord which is elevated and retracted; (f) suture of the divided aponeuroses of the external oblique over the cord; (g) suture of the subcutaneous fascia and skin.

mercial fascia lata, one; patient's own fascia lata, four. The problems associated with recurrence in the same patients are described more fully below.

We should mention that the recurrences occurred in the majority of instances in patients who were operated upon at other hospitals the first time. Brief notes of their cases are made to summarize the nature of these cases.

CASE REPORTS

CASE I. Psychosis with mental deficiency, imbecile, age 54, had been suffering from a hernia for "many years" which was repaired for the first time in 1933 at another hospital. A second attempt at repair was made at this hospital in September, 1934, at which time it was noted that the previous repair had been of the Halstead type, with cord transplanted beneath the skin. A direct herniation was found through the fascia transversalis. The hernia was repaired on the right with patient's own fascia lata. On October 29, 1934, the left hernia was repaired, the usual operation with transplantation of the cord was used. The left hernia recurred shortly after the operation and was again repaired on January 4, 1935, at which time it was noted that anatomic landmarks were markedly obscured and the patient's own fascia lata was used. This recurred shortly after operation and on March 1, 1935, a left orchidectomy was done and the usual type of operation utilized, since which there has been no recurrence. Patient also has multiple sclerosis, a hypertrophied prostate and had previously been operated upon for papillary adenocystoma of the thyroid gland.

CASE II. General paralysis, age 58, had been operated for the first time in 1935, and on March 28, 1936, a bilateral recurrent indirect inguinal hernia was noted. A fascia lata transplantation operation was done. The course was complicated by elevated temperature and four weeks later the hernia recurred. On July 31, 1936, a bilateral repair, regular operation, was again attempted, and there was recurrence on the left shortly after the operation.

CASE III. Patient, age 32, suffering from a traumatic psychosis, was operated upon February 16, 1935. The wounds became abscessed; the patient kept them opened with his fingers in spite of supervision. He later stated that he

did this because he did not wish to live and thought that if he infected his wounds this would hasten his death. The hernia recurred and he was re-operated upon September 9, 1937; a fascia lata repair, commercial type, was done and the hernia did not recur.

CASE IV. The patient age 29, imbecile, had a right inguinal hernia present since birth, and was operated for the first time in 1930, with a recurrence in 1933 at upper end of the scar. Operation was performed here for the first time on June 6, 1936, his own fascia lata being used in the repair, with recurrence in March, 1937. Re-operation took place on May 18, 1937, with a commercial fascia lata, without recurrence to date.

In evaluating the results, various factors warrant serious consideration, the same factors that have to be kept in mind at the time that the original repair is considered. (Table IV.) At least 26 per cent were of more than one year standing and 16 per cent of more than five years standing as far as the clinical manifestations of hernia could be noted from the records. General gas-oxygen ether anesthesia was used in all cases except four, in whom spinal anesthesia was used. On this small number there is no object in trying to relate recurrence to the type of anesthesia used. It was the opinion of Longacre[4] in his group of cases that "the difference in the percentage of recurrence as related to the type of anesthesia used in the operation is very small."

TABLE IV

Duration of Hernias	Number of Cases
30 years	1
26 years	1
23 years	2
20 years	1
5–10 years	7
2–5 years	4
1–2.5 years	3
6 months–1 year	8
3 months–6 months (1 postoperative)	8
Less than 3 months (1 herniation of omentum)	26
Unknown (1 umbilical, 1 postoperative)	12

Various postoperative complications were noted: infected wounds in nine in-

stances; unexplained elevation of temperature in fourteen instances; bronchopneumonia in four instances; unexplained cough in two instances; postoperative atelectasis in one; swelling of the testes in two instances; distention in one instance. Of the patients who suffered recurrences after repair only four had an uneventful convalescent period. Various associated findings were noted, the most important being the muscle and fascia deficiency; tissue turgor and poor muscle tone were encountered in the majority of the abdominal walls. This was present in practically all the cases and to a very preponderant degree in seven cases. These must undoubtedly play a large role in the recurrence of hernias after operation. The associated conditions of note were elevation of blood pressure, hemorrhoids, varicocele, hypertrophied prostate, tumor of thyroid, varicosities, cardiac complications, von Recklinghausen disease, congenital syphilis and tuberculosis. Incarcerated hernias were found in five instances, scrotal hernias in seven.

Chromic catgut sutures were used in all the operations with silk used in the skin. Although no special catgut sensitivity tests were made, no such phenomenon was observed.

DISCUSSION

The above brief case histories illustrate in part at least some of the difficult aspects of the hernia problem in mentally sick and mentally deficient conditions. There are always many factors to be considered which are present in the same cases, viz., the patient is often not only a medical, neurologic and psychiatric problem but has distress occasioned by a hernia. Many patients do not complain of the symptoms found in normals, i.e., bulging in the region without pain, but wait till the hernia has become quite large or has started to produce definite distress, many times more objective than subjective. The cooperation so necessary in these cases is often lacking in the mentally ill; they will pick at their wounds; they will refuse to stay in bed, etc. These problems can be minimized only by the constant vigilance of the nurses and attendants who often must distribute their labors over many tasks. Limitation in numbers of personnel is a familiar observation.

There is one feature of interest—the relatively greater incidence of direct inguinal hernias in mental cases as compared to normals. There is too little known of the distinctive forces leading to the occurrence of direct and indirect hernias to offer a satisfactory explanation of this paradoxical situation. We have mentioned the common findings at operation of deficiencies in muscle and fascia, both in structure and extent. It appears reasonable to assume that these deviations are perhaps part of a greater defect evidenced by the mental states leading to hospitalization, on the one hand to mental hospitals and on the other to hospitals for the mentally defective. In the latter instance this explanation appears more plausible since organic defect is more readily visible and the variety of somatic abnormalities is more extensive as well as more common. Dietetic factors as well as physical exercise must also be considered from a theoretical point of view as causative agents in producing muscle and fascia defects. However, the average patient in state hospitals eats a well balanced diet and takes part in sufficient physical stress as to diminish their importance as such causative factors.

The relation of the duration of the hernia and recurrence appear worthy of some comment. It is obvious that there is a direct ratio of age of hernia to size of hernia and consequent strains upon fascia and muscle. Nevertheless, it is our experience that this becomes important only insofar as the condition of the fascia and muscles varies from good or poor. Indeed it is not implausible that the common finding of poor tissues accounts for the size of the hernia even in early cases. The choice of operation is determined by the condition of the tissues at time of operation. We are of the opinion that reinforcing measures, such as

fascia lata, become imperative when poor fascia and muscle are encountered. In extreme cases, orchidectomy is advisable to obviate the recurrence which experience teaches is almost inevitable in such cases.

The relative advantages and disadvantages of commercial fascia lata and autogenous fascia lata can not be satisfactorily determined from the small number of cases. In our series commercial fascia enjoys a slight advantage from the point of view of percentage of recurrence. Additional advantage accrues from the lack of additional operative work required, with consequent increase in total time of operation, as well as added nursing care and discomfort to the patient. The latter, from our point of view, becomes an important factor. We have, however, had none of the complications feared by removing the patient's own fascia lata, such as rupture and herniation of muscles nor infections of the thigh operations. In the case of commercial fascia lata where postoperative infection of the herniorrhaphy occurred, it could not be satisfactorily determined whether this was the result of the fascia lata or the patient interfering with the normal process of postoperative sterility and repair. On the whole, we are inclined to continue the use of commercial fascia lata because of its advantages as already discussed. We are furthermore disposed to believe that it is the method of choice in the majority of herniorrhaphies performed on mentally ill and mentally deficient patients suffering from hernias even where extensive tissue defect is not present. The extended use of fascia lata repair in non-psychotic and non-defective

groups suffering from hernias is worthy of serious consideration.

SUMMARY

1. A follow-up of hernia repair in fifty mentally sick and mentally deficient patients is presented.

2. Nineteen patients were more than 50 years of age, twenty-four patients were between the ages of 25 and 50.

3. There was a total of seventy-three hernias, 93 per cent, or sixty-eight of which were inguinal; 47 per cent, or thirty-two were direct inguinal hernias.

4. Six patients had been previously operated upon elsewhere with many years interval since the original operation. The largest percentage of recurrences occurred in this recurrent inguinal group of cases.

5. Sixty-one per cent of the hernias did not occur with a follow-up of one to four plus years duration. Seventy-five per cent of the patients treated did not have a recurrence.

6. Some of the difficulties in the management of patients of this type are pointed out.

7. The type of operation among this group of patients is considered.

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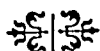
LYMPHOSARCOMA

REPORT OF THREE APPARENTLY CURED CASES

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THE pathologic diagnosis, "lymphosarcoma," usually implies a fatal outcome. The life expectancy after diagnosis averages two years; 85 to 95 per cent of patients die before the expiration of five years and survival for a period of ten years is extremely rare.[1,2] In our files we have found three cases with survival period of six, eight and eleven years, respectively. At the present time there is no evidence of the disease in any of the three patients. The diagnosis was made histologically and found support in clinical observation and gross study. We do not believe that these lesions are benign lymphomas, a condition so rare and so nondescriptive that its existence finds repeated denials. Because unmistakable evidence to support the diagnosis was present, we prefer to consider that two of the patients were cured by early operation and one enjoys the rare distinction of spontaneous regression. We are fully cognizant of the difficulties in diagnosing primary malignant tumors of lymphnodes and we make no claims to infallibility, but each slide has been reviewed by at least four competent pathologists and their conclusions have been identical. We, therefore, record these cases for any light that may be thrown upon such an unfavorable disease and for any hope that they may offer to the patient and physician.

REPORT OF CASES

CASE I.   A white male, aged 37 years, was admitted to the University Hospital February 2, 1934. For eight months he had noted progressive general lassitude, anorexia and vague indigestion. Nausea and vomiting, without relation to meals had developed during the previous few weeks. There had been moderate loss of weight for three months. The few days prior to admission he thought that he had fever which was accompanied by "fever blisters."

He appeared somewhat wasted and pale. A scaly dermatitis was observed on the dorsum of the hands. The superficial lymphnodes were palpable. The abdomen was on a plane with the thorax and was tender to deep pressure in the epigastrium. Erythrocytes numbered 4,100,000 per cu. mm. and hemoglobin was estimated at 85 per cent. The leukocytes totaled 7,000 per cu. mm.; 69 per cent were polymorphonuclear neutrophiles, 24 per cent lymphocytes and 7 per cent were monocytes. Fluoroscopic examination with an opaque meal revealed an irritable pylorus and a suggestive filling defect. Occult blood was present in the feces. The gastric fluid contained an excess of free hydrochloric acid. Wassermann and Kahn reactions on the blood were negative. The clinical impression was chronic peptic ulcer of the pylorus with partial obstruction.

For one month a modified sippy regime failed to relieve the symptoms. Nausea and vomiting persisted and loss of weight was progressive. Surgical interference was deemed advisable. At operation a diffuse induration of the pylorus was noted. The serosa of the stomach was studded with small, firm nodules which were more numerous near the cardia. A posterior gastroenterostomy was performed and two small serosal nodules were removed for histologic study. The postoperative diagnosis was carcinoma of the stomach with lymphogenous spread to the serosa. The patient made an uneventful recovery and despite refusal of postoperative radiation therapy he gradually regained his health and is now living and well, six years after operation.

The histologic diagnosis was lymphosarcoma. The two small sections of tissue, without evidence of capsules, were 0.5 and 0.7 cm. in diameter. Microscopically they were composed of adipose tissue which was diffusely infiltrated

by a newgrowth of small spherical cells which resemble lymphoblasts. The cytoplasm was scant and generally indistinct and the nuclei were hyperchromatic. Many mitotic figures were seen. The cells were supported by a delicate reticulum and there was no orderly arrangement. Gradual replacement of the fat cells could be observed. (Figs. 1 and 2.)

CASE II. A white male, aged 26 years, was admitted to the hospital May 14, 1932. He had noted a swelling at the angle of the left jaw for three weeks. As the mass gradually increased in size it became tender to pressure and later painful. Five years previously he had a similar mass on the opposite side which had been removed surgically and no pathologic examination was made. Two years previously a swelling at the site of the present tumor had completely regressed after incision.

He was well nourished and developed. A firm, freely movable mass 4 cm. in diameter was noted at the angle of the left jaw. It was slightly tender. There was no evidence of disease of the nose, mouth, throat or ears. The inguinal lymphnodes were palpable. Hemoglobin was 83 per cent and the leucocytic count 5,900 per cu. mm. Polymorphonuclear neutrophiles were 57 per cent, lymphocytes 40 per cent, monocytes 2 per cent and eosinophilic leucocytes 1 per cent. The Wassermann reaction of the blood was negative. The node was removed and a pathologic diagnosis of lymphosarcoma was made. Over a period of three weeks he received 1,600 roentgen units of therapy at the site. The patient is living and well eight years after removal and there has never been any recurrence or spread.

The gross specimen was a cellular encapsulated mass 4 by 3 by 3 cm. and on section was grayish, granular and slightly lobulated. Microscopically, the capsule of connective tissue was broad but was invaded by tumor cells. The architecture of the lymphnode was destroyed by a new growth of moderately sized cells with round, vesicular and hyperchromatic nuclei and scant cytoplasm. There was slight variation in the size of the cells. These tumor cells grew in irregular strands and groups throughout the lymphnode and were replacing the easily recognizable pre-existing lymphocytes. Many mitotic figures were seen. Karyorrhexis was prominent. (Fig. 3.)

CASE III. A white female, aged 47 years, was admitted to the hospital May 12, 1929. She

was a nervous individual with multiple complaints, chief of which were general lassitude of three or four months' duration and frequent attacks of diarrhea. Two months previously she had noticed a painless mass in the left inguinal region. The mass had slightly increased in size during this period.

An enlarged inguinal lymphnode, the size of a lemon, was the only significant physical finding. This was firm, fixed but not tender. The erythrocytes numbered 4,200,000 per cu. mm. and the hemoglobin was 80 per cent. Leukocyte count was 6,100 with 67 per cent polymorphonuclear neutrophiles, 23 per cent lymphocytes, 6 per cent monocytes and 4 per cent eosinophilic leukocytes. The Wassermann reaction on the blood was negative. The enlarged inguinal lymphnode was fixed to the surrounding tissue and was removed by blunt dissection. This was followed by roentgen ray therapy of 1,200 R. units over a period of five months.

The lymphnode, 4 by 4 by 2 cm., was limited by an apparent fibrous and fatty capsule. The cut surface was uniformly grayish and granular. Small yellow foci of fat, incorporated in the grayish tissue peripherally, indicated capsular invasion. A curved fibrous strand, continuous above and below with the capsule, separated the lymphnode into two unequal parts. The specimen seemed to represent a single node whose capsule had been penetrated. The node, however, was delimited by a pseudocapsule. Microscopically almost all of the architecture was obliterated, because only an occasional follicle could be seen. The sinuses were not apparent. The cells resembled lymphoblasts, the nucleus was round, vesicular, hyperchromatic and the cytoplasm was scanty. Some larger cells were present and there was an occasional true tumor giant cell. The capsule was invaded by these cells and they grew irregularly into the fat. The fibrous strand seen grossly is a broad sheet of loose collagenous connective tissue and on one side the cells are seen to have destroyed the pre-existing lymphnode and have extended through this strand into the adipose tissue. The patient is living eleven years after operation and there is no evidence of recurrence or extension. (Fig. 4.)

DISCUSSION

The survival period is not necessarily a criterion for cure of a malignant disease, but absence of recurrences and metastases

must also be considered. Radiation therapy may sometimes prolong the survival rate well past a ten-year period and still the period. Recent reports in the literature give a better prognosis than the older ones. Craver[5] reported a survival rate of five
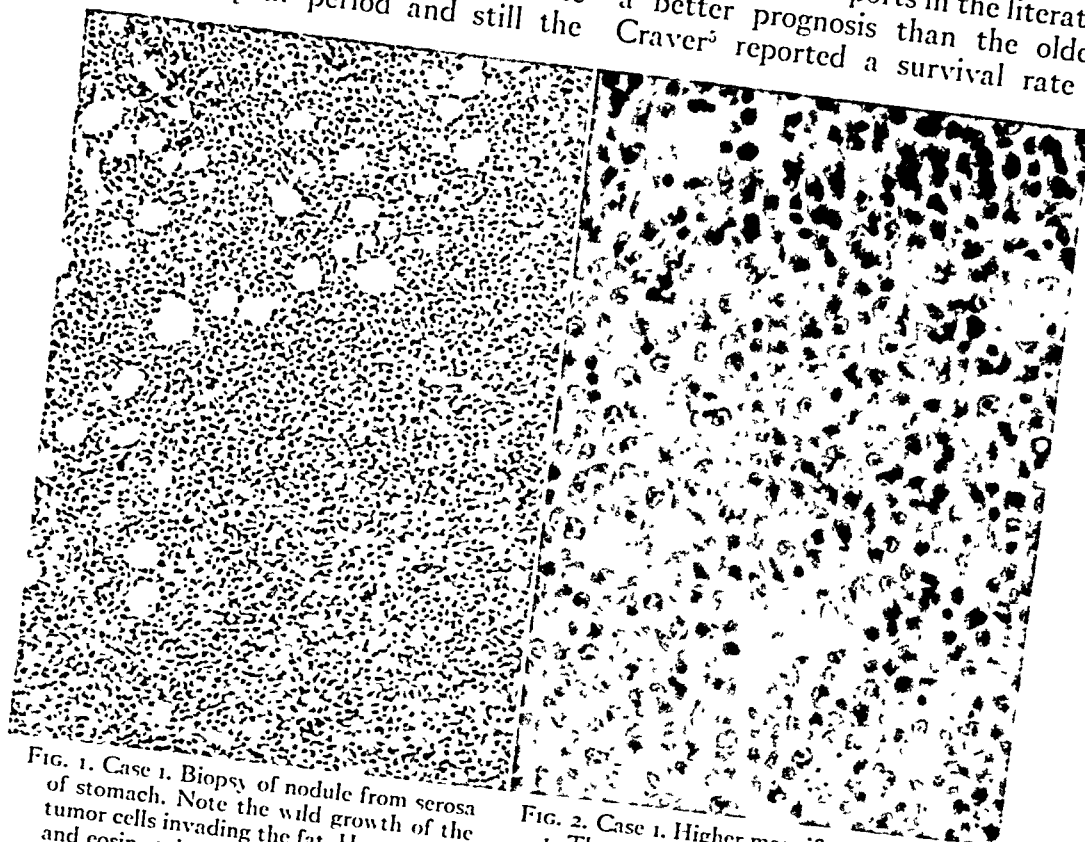
FIG. 1. Case 1. Biopsy of nodule from serosa of stomach. Note the wild growth of the tumor cells invading the fat. Hematoxylin and eosin stain. × 155.

FIG. 2. Case 1. Higher magnification of Figure 1. The tumor cells resemble lymphoblasts with hyperchromatic nuclei. Mitotic figures can be seen. Hematoxylin and eosin stain. × 540.

disease may be present. A patient with Hodgkin's disease has been known to survive twenty-six years[3] and lymphatic leukemia has been held in check for twenty-five years.[4] While only one of our patients has survived the ten-year period, absence of recurrences and metastases in the other two, after periods of six and eight years, indicates a probable cure.

Nathanson and Welch[1] followed 310 cases of malignant lymphoma, which included lymphosarcoma, lymphocytoma and giant follicular cell sarcoma. Only 6 per cent survived five years and 1.6 per cent were living after ten years. Of the fifty-five lymphosarcomas in their series, all died before the expiration of ten years and 82 per cent died before the fifth year. In Jackson's series,[2] the survival rate is similar; 17 per cent survived a period of three years and none were living at the end of the ten-year

years for twenty-one patients (15.9 per cent) of 132 patients treated with roentgen ray for lymphosarcoma. Five of these died after five years while two are living with evidence of the disease so that fourteen or 10.6 per cent are now living without evidence of the disease five years or longer. Hertzler[6] has aptly stated that a patient with lymphosarcoma rarely lives more than one or two years even in this day of roentgen ray therapeutics. If one does, the accuracy of the diagnosis is challenged and the case should be restudied.

We have repeatedly reviewed our specimens and find that both grossly and microscopically the criteria for the diagnosis of lymphosarcoma are present. In Case 1 it was presumed that the primary growth was from the submucosal lymphnodules of the stomach and only the secondary growths

were studied. These were distributed along the lymphatics and presented a mass of lymphoblasts which were invading the surrounding tissues.

of lymphosarcoma. Surgical interference, other than relieving the obstruction, cannot be given credit for a cure in the first

FIG. 3. Case II. Section from lymphnode. Pre-existing lymphocytes are being replaced by a new growth of larger cells which resemble lymphoblasts. The architecture of the node is destroyed. Hematoxylin and eosin stain. × 120.

FIG. 4. Case III. Section from lymphnode. Remains of the original capsule are represented by fibrous strands which have been penetrated by the new growth. Adipose tissue is incorporated in the new growth. Hematoxylin and eosin stain. × 120.

rounding tissues. In Cases II and III the primary newgrowth was probably removed completely. There was destruction of the architecture of the lymphnodes by a newgrowth of lymphoblasts, invasion of the capsule, and in Case II, replacement of pre-existing lymphocytes by a more anaplastic type of cell could be observed. In each patient the existence of inflammatory foci was sought for but not found. The blood picture and clinical course eliminated the possibility of leukemia and infectious mononucleosis, and in all three the Wassermann reaction on the blood was negative. In diffuse hyperplastic tuberculous lymphadenitis, the degree of recticulo-endothelial hyperplasia is characteristic.

We are, therefore, forced to the diagnosis

case. A mistaken diagnosis or spontaneous regression are the only alternatives. Recently, Taylor[7] in a review of 152 cases of lymphosarcoma of stomach found that thirteen patients were living and well five to twenty-two years after the diagnosis. Seven of them were treated by surgery alone, two by surgery and radiation and four by radiation alone. He concluded that radical surgery was the treatment of choice. It is interesting to note that in one of his patients the surgical incision passed through the newgrowth and yet without radiation the patient is living nearly six years afterwards. Another patient with definite metastases received only 1,380 roentgen units of treatment and has sur-

vived seven years. Archer and Cooper[8] found ninety-four additional cases to those of Taylor and in these there were thirteen five-year survivals, one with surgery alone, four with surgery and radiation and eight with radiation alone. He was impressed by the fact that inadequate surgery and radiation have effected five-year cures of lymphosarcoma of the stomach. It seems evident from these recent reports that lymphosarcoma of the stomach not infrequently undergoes spontaneous regression. However, in our other two cases it is possible that the tumor was removed sufficiently early to cure the patient. The absence of recurrences and metastases does not negate a diagnosis of malignancy in other neoplasms and should not in the case of lymphosarcoma. If we consider that lymphosarcoma begins in a single node or closely related nodes, surgical removal, before extension into the surrounding tissues or lymphogenous spread to other lymphnodes, should result in a cure.

SUMMARY

Three clinical cures of lymphosarcoma are reported.

Spontaneous regression occurred in a lymphosarcoma of the stomach, after surgical relief of obstruction.

Surgical removal of early lymphosarcoma of a lymphnode resulted in a cure in two patients.

None of the patients received adequate roentgen-ray therapy.

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THE USE OF ILIAC BONE IN FACIAL AND CRANIAL REPAIR

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CONDITIONS inviting surgical intervention in the cranial and facial areas are attributable to malformation or to injury. We are here concerned with such conditions as relate to loss and displacement in the bony framework of the head.

Malformation, for example, is a congenital condition which applies to the mandible, superior maxillae and nasal bones. The mandible, cheek bones and outer nose are notably susceptible to displacement by impact. Definite losses of bone are produced by other orders of injury. A displaced zygomatic arch may be susceptible of being raised by leverage and the facial contour so restored; on the other hand, in many instances depressions caused by injury can be restored to true surface level only by bone or cartilage replacements or insertions. The level changing material may be artificial, as stent, or it may be cartilage or bone. If bone, there will be need for choice of the donor area. The bone that experience has shown to be best for other areas of repair may not be best here.

What dictates election for one bone substance rather than another is recognition of differences in quality and structure. Bone of notably compact structure is best in some conditions, while cancellous, "spongy" bone is better in others. It is because the ilium is the best provider of "spongy" bone that it presents the most advantages in replacements in facial and cranial repairs.

The general excellence of cartilage is not to be disregarded. It would be the perfect material for many of these repairs were it not for two limitations: One is that it has a tendency to curl, thus producing, in time, a twist that spoils an otherwise perfect job. The other limitation is that it may work loose from an association with bone and create a new distortion. Cartilage has the invaluable property of being lymph nourished. As a lymph supply is present in any situation in which it may be placed, its viability is not impaired by complete detachment from its original surroundings.

Other grafts are less favorably endowed. For example, the free full thickness skin graft has its nerves and vessels put out of action when it is raised; it cannot live without them and must await their restoration. Similarly, bone is nourished by blood vessels whose continuity is interrupted when it is excised.

Bone surface, however, becomes adherent to bone surface by the true adhesion of osteogenesis, whereas cartilage becomes affixed to bone only by a medium of connective tissue; and while over a small area the fixation may be so firm that only by the chisel can it be released, in larger amounts it may yield to displacement by even the mild action of adjacent soft tissues or by its own tendency to curl. The removal of the perichondrium lessens but does not with certainty remove the probability of curling, but no one can foresee what may be the influence of changes in the body chemistry which result, now and then, in some change in the structure of the cartilage tissue. Cartilage inserts will nicely eliminate many a facial depression and restore the surface level; but if it begins to curl, the result is an equally objectionable protrusion. Considerations such as these made it imperative to consider the substitution of bone for cartilage as a more dependable material of repair.

Bone, however, is permeated by blood vessels. Its utility as a transplant is governed, at least to some extent, but its ca-

Time is an element of importance in the surgery of repair. The longer it takes for a bone graft or any graft to revive, the less is
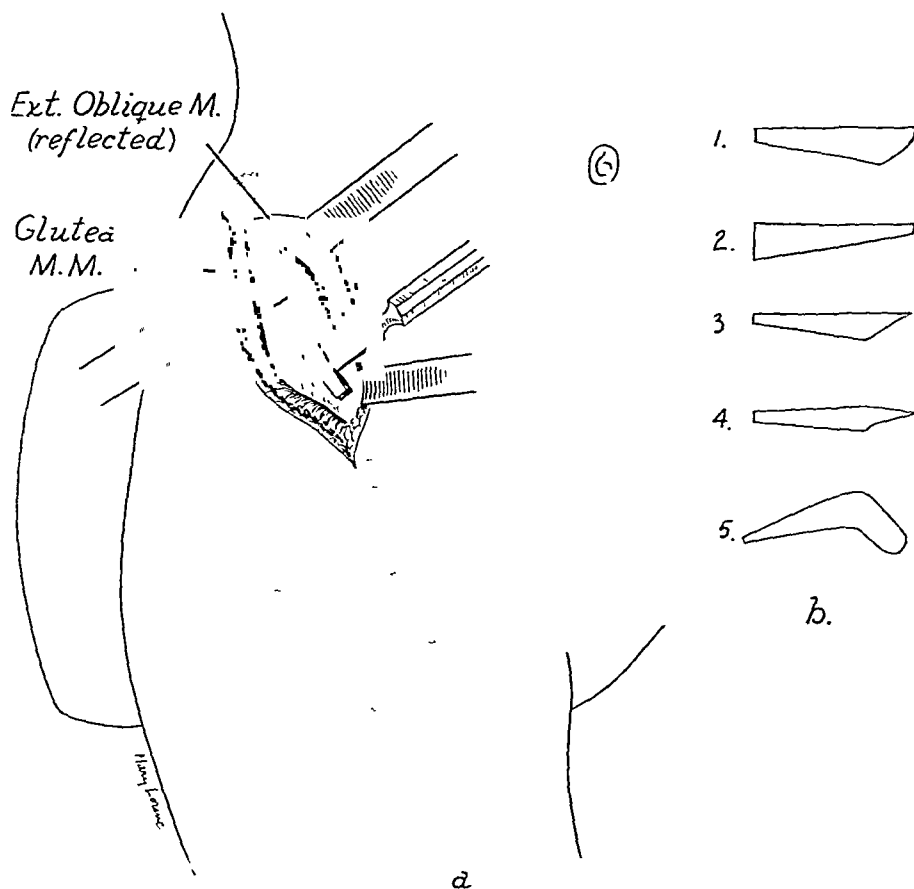
FIG. 1. A, exposition of ilium for removal of small grafts from its outer aspect. B, nasal support grafts. They vary from one and one-fourth to one and three-fourths inches long; one-eighth to one-fourth inch thick.

pacity for resuming vascularization. Bone that is best adapted to such restoration commands a preference over bone in which it is less rapid. Uncertainty as to the viability of a bone transplant, for this or other reasons, is expressed in the accepted surgical maxim that, to live, bone must be in contact with bone at both ends of the graft. It must be sustained from within, whatever may be added in the way of sustenance from the tissues that invest it. But when a bone graft lives in contact with other bone, the two become inseparable through osteogenesis. There is no confusion such as is met with when cartilage twists or slips.

the assurance of success. If the density of the bone is such that it offers resistance to infiltration of blood supply, nothing much can be done to accelerate the process. On the other hand, if the graft is of such composition that vascular return is facilitated, the repair moves rapidly to a successful conclusion. Hence we depart from the broad ground that bone is bone, and seek the source of a supply that will afford, in this direction, advantages that other sources do not. In relation to the repair in the facial and cranial areas, iliac bone does possess this advantage.

It is well to remember that there is much about bone of which we are none too sure.

Conflicting opinions are held by high authorities, who cannot all be right nor all be wrong. There are those who hold that

The question that arises is whether, if the weaker bone is used, it will in the new situation be equal to the demand made
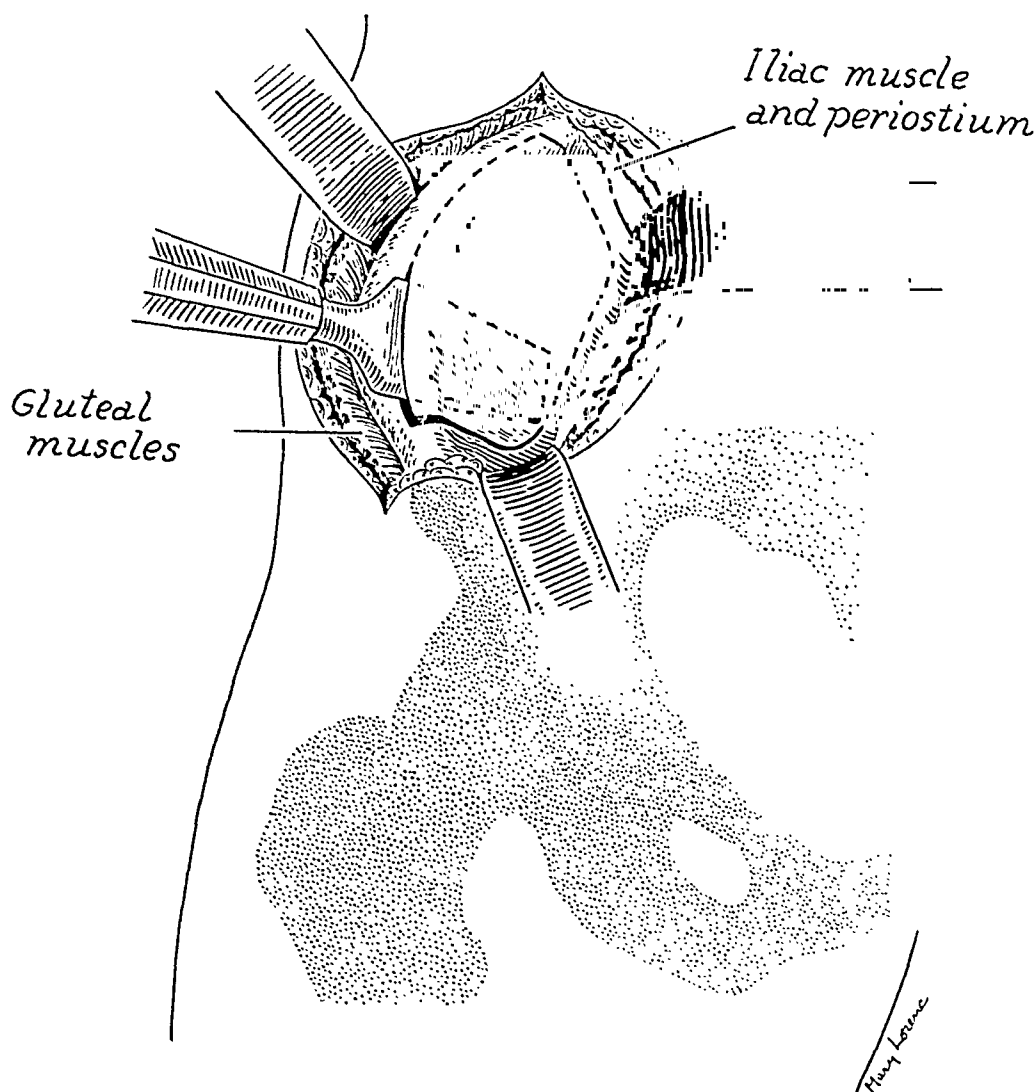
FIG. 2. Removal of bone from inner aspect of ilium to replace large bone losses.

bone growth proceeds from the periosteum, and those who consider the periosteum a mere inclosing membrane whose importance diminishes as it becomes thinner with advancing years. There are some who hold that the periosteum facilitates vascular communication, and others who are committed to the precisely opposite view. There are hard, compact bones, at and just below the surface, with all the strength needed for their special functioning, and there are other bones so placed that there is seemingly less need for strength, and in which cancellous, even "spongy," bone is found in larger proportion, but is just as truly bone as the other.

upon it; and whether, if the more compact bone is used, it will lose some of its strength because of slow vascular return or for any other reason. As to the periosteum, at least we know that we cannot have it on both sides of a graft. Is the graft, then, better for having it on one side, or can it be dispensed with on both sides without danger of that exfoliation which some consider to be the inevitable consequence of its being withdrawn? In its normal situs, the proportions of animal and mineral constituents of bone are suited to the immediate needs. Will they, or is it necessary that they should, remain in the same proportions in the new situation to which the graft is transplanted?

The mineral content may be as high as 70 per cent. Have we the assurance, or do we need it, that there will be no absorption of the mineral content under the new vascular conditions? Even as to the animal constituents we cannot be too sure. There is no certain guide, as yet, to determine how long the cells of bone continue dormant, or how soon they become lifeless. What I do know is that after a bone graft had been in sterile medium for some time I used it to construct a nasal bridge, and after a year there is no sign of its not being entirely adequate. There is still much to be learned from that refinement of the process of trial and error which we call research.

The application of these reflections is indicated if we consider, for example, what happens when we have to do with such a case as that in which the frontal bone covering of the frontal sinus has been crushed in on one side or both. The facial symmetry has been impaired. The surface level has been depressed. In the replacement to restore it there will be no hesitation in preferring bone to cartilage; but in choosing the donor area a controlling consideration will be that the bone graft must be shaped to a form that will restore the esthetic balance of the face. A reminder of the procedure will explain why the operator must ponder the differences between one donor bone area and another.

A plaster cast of the injured area shows the nature of the depression. With a mould of stent, a pattern can be made of the bone implant that will restore the normal contour. With this, after inspection of the bony base, a model of the graft can be fashioned using a piece of bone to be had from the nearest butcher. At once it becomes evident that the graft must be shaped to conform to the curved surfaces of the pattern. No flat, hard bone will serve for this manipulation as well as a "spongy" bone substance will. The curved outline of the ilium and the readily shaped material within that curve at once suggest the best available choice. The only remaining question is whether the transplant of soft bone has the

strength that should be provided in that region. Except against violent impact, there is no doubt that the protection is ample.

In other cranial areas, the same considerations apply to filling depressions caused by the bones being crushed in. Where there has been actual loss, or where a surgical defect is to be made and subsequently covered, the advantages offered by the curved iliac bone may not be so impressive. Where protection of the brain is an issue, there can be no rule of thumb. Ordinarily, the borders of such defects are brought to a more or less circular pattern, with half-thickness bone bearings upon which similarly halved edges of the graft will be stepped A graft of hard bone may serve, but the iliac bone with its curved surface commends itself as an aid to the solution of many such problems.

A fairly familiar effect of pressure injury in the superior maxillary area is the displacement or fracture of the zygomatic arch. If it can be raised by leverage applied from the temporal area, no replacement is necessary; but in some instances there must be such replacement, and, for the same reasons that apply in the frontal area, recourse should be made to the easily shaped iliac graft. It may be mentioned that in such situations the iliac graft displays a resistance to infection and a capacity for recovery when drainage is necessary, all of which adds to the esteem in which it is held.

Another type of injury is that in which the antrum, the malar bone, perhaps the infra-orbital border, are crushed in, with resultant facial depression. There is little or no prospect of readjusting the depressed structures. One should have recourse to an onlay graft over the whole area with possibly some local replacement in the orbital section. As may be imagined, these extensive onlays inserted below the soft tissues may present postoperative problems, of which infection and the effort to expel are not the least. Here again there appears to be, in the "spongy" bone of the ilium, an

exceptional capacity for surviving these threats with the aid of drainage, that is possessed in lesser measure by the harder compact bone.

The goodly size of many of these onlays reminds one that in certain war wounds, in which the cranial loss is very extensive, the possibility of recourse to the ilium on both sides with the quantity of curved transplants they combine to supply can be a great solace to the operator who has such a defect to deal with, as was my experience when I joined the White forces in the recent war in Spain.

The congenital maxillary deficiency to be observed in the plane next to the dental area does not call for bone graft. Here the correction of level is best attained by a removable dental appliance resting within a buccal inlay.

Transplants to the mandible are used for the purpose of adding to its length. This may be necessary when, after injury, or from congenital inadequacy, dental malocclusion and attendant evils call for some lengthening of the lower jaw. Here a graft of hard bone, as from the tibia, may serve the purpose; but it can be said that the choice might well be the iliac graft, because of its many advantages. This graft includes a curved border that goes nicely with the natural underturn at the lower margin of the mandible and is also readily shaped to adapt it to the "steps" fashioned in the parts it is to hold together. Ability to conform it accurately to measurements made in advance, resulting facility of operation and minimum delay in subsequent co-ordination with its host, still further commend the iliac graft in these corrections of the mandible.

Advancement of the mandible may or may not be associated with correction of the receding chin. The condition may exist when there is no accompanying dental malocclusion. Independent correction may be effected by introducing cartilage or bone to overly the symphysis in such thickness as will correct the recession and produce an acceptable contour. The difficulty with

cartilage is that it may work loose because of the imperfect binding of cartilage to bone by connective tissue. This distortion, since it can be foreseen as possible, is to be averted. A rounded bone graft, united to the mandible at the symphysis, is not subject to such shifting once the osteogenesis has got well under way. It is obvious that, since there is modelling to be done, the easily manipulated iliac bone is not to be overlooked in this correction.

Consideration of the relative advantages in the use of bone and cartilage in reconstruction of the nose opens a somewhat wider field of discussion. We may exclude from it all application to those instances, and they are many, in which the correction can be effected by readjustment of the existing elements. If the nasal bones, though displaced by trauma, can be brought to an arch of proper height, the nasal septum be fitted to continue the line of the dorsum and serve as a buttress for the surrounding tissues, the cartilages of the alae and the columella be readjusted to give form to the nostrils and nose tip and any small depression on the dorsum be filled by morsels excised and saved in this latter process, no question of either bone or cartilage transplant supervenes.

That question does arise when the destruction is so serious that to give form and support to the nose some firm material must be added to the structure. If cartilage is used it must be taken from the costal crest, an undertaking of considerable magnitude surgically for the small amount of cartilage to be taken. Apart from the extensive character of the nerve block and the insult to the tissues, the possible perforation of the pleur sac is to be apprehended. If cartilage can be excluded, resort must be made to bone. The tissues, as a rule, will not tolerate such foreign substances as ivory, silver or gold. In this reparative surgery of the nose the experience with bone in the early years was not encouraging. There was observed a tendency to absorption of the bone substance at the end of the transplant distal from its attachment

at the glabella. That, of course, resulted in a letting down of the tissues at the nose tip, a condition ruinous to the repair. It is probable that, in at least some instances, the bone chosen for the transplant was drawn from sources which surgeons had relied upon in bone grafting of other kinds. Whether the failure was due to the texture of the material chosen or to some other reason, the use of bone in nasal replacement gave way, generally, to the employment of cartilage. The flaw in regard to cartilage was its tendency to twist, to the disadvantage of the line of the dorsum. It is fair to say that this limitation has been more repugnant to the eye of the surgeon than to the majority of such patients as were affected by it, for these are content, in reason, with the improvement over the original condition and do not complain.

Experience gained in recent years in the use of the soft bone of the ilium in transplants in a diversity of other procedures has led to a reconsideration of the earlier decisions. The facility of vascular renewal displayed by this soft, "spongy" bone was something to work with. If this could be depended upon, it appeared probable that such a bone graft would provide an acceptable and durable division wall for the nose and an adequate support for its tissues, if the septum was incapable of serving those uses.

This deduction has been justified by results, but there are some limitations to be noted. There is no problem as far as relates to contact between the transplant and the nasal bones if there are remainders of these last sufficient to establish contact from the glabella to the lower end of the bony arch. If, however, the transplant is carried, unsupported otherwise beyond that last point of contact of bone with bone, it becomes a nice question as to how far the projection should extend. The answer appears to be that if the extension is for only a short distance, the extension derives sufficient sustenance from the main body of the bone; but if the extension is carried too far in the direction of the nose tip, an expedient to which the temptation may be great, the

old rule that bone must be in contact with bone at both ends is apt to assert itself, the penalty for overconfidence being absorption at the bone end and drooping of the nose tip. Experience points to an underestimation of the possible security of extension rather than to an assumption of even minimal risk.

The inadequacy of the septum is what leads to this temptation. If it can sustain the line of the dorsum, no bone transplant is needed beyond the end of the bony arch. If, evidently, it is not, the wiser plan is to so shape the bone graft that one end can be given contact with bone at the spine of the maxilla, even if to effect that contact it is necessary to discard some part of the septum. In extreme instances, the bone graft may replace the whole of the cartilaginous septum clear back to the ethmoidal process. In removing part or all of the septum the perichondrium and its investing membrane are spared. Their ensuing contact with the bone are an aid to renewed vascularization. A bony midwall of the nose may not be as pliable as one of cartilage, but the patient will accustom himself to the difference. The iliac graft does, in fact, do well in these conditions. Its surfaces have been observed to take on a cortex that adds to its firmness. There are, it is true, the perils of infection. One may not be be too much surprised if, for this reason, a part of the graft proves to have been absorbed and must be replaced. Here again, however, note is to be taken of the high resistance to infection that the iliac bone seems to possess. Some remarkable instances of this have been within my own experience.

A consideration of importance is that the bone from which the graft is taken is more readily approached than is the costal crest, the source of cartilage grafts. With proper precaution, the graft, if in small quantity, can be taken from between the curved surfaces of the ilium without exposing the patient to much postoperative pain. It is always well to bear in mind that unnecessary insult to the muscles that find attachment to its anterior surface may result in

lameness and in pain; and that the inner surface, which it is sometimes desirable to take, immediately adjoins the peritoneal cavity. And, of course, no one would venture upon intervention without careful provision for the respect that is due to the vessels and nerves.

SUMMARY

The iliac bone presents to those who engage in an intensive effort to perfect the methods of repair of facial and cranial injuries and deformities a definite addition to the resources at their command. Its location, its form, its texture, its proved viability in new situations, its capacity to overcome incipient infection, the relative facility with which it can be shaped, all commend its use. What is more to the purpose, the expectations founded upon these qualities have been fulfilled under the test of experience.

Addition: We wish to add the following biographical notes to the write-up of Dr. Henry Hamilton Moore Lyle, which appeared in our January issue, page 20. Dr. Lyle was appointed to the Field Staff of the Chief Surgeon, First Army in charge of the western section for the evacuation of wounded in the St. Mihiel drive. On September 30, 1918, he was appointed Director of ambulances and evacuation of the wounded of the First Army during the Meuse-Argonne offensive. Dr. Lyle was also Chief Consultant Surgeon of the First Army, a member of the Gas Warfare Board and was appointed A.E.F. Colonel on October 23, 1918.

REBUILDING THE ALVEOLAR PROCESS
AND THE BUCCAL SULCUS*

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THE bones making up the jaws have for their principal function that of support of the apparatus by which food is masticated. This function is accomplished through the teeth set in the alveolar ridge which rests upon the free surfaces of the superior maxilla and mandible, respectively. When either ridge is absent through loss of boney tissue, a denture cannot be applied to that jaw in a satisfactory manner for there is nothing to which it may be fixed.

When the teeth are lost, the gums usually retract and fit firmly over the surface, giving sufficient height and rigidity to hold a denture. However, in many other patients the mucous membrane is thrown up into loose, movable, non-rigid, scar infested folds which may or may not be painful. In any event this flaccid condition of the mucous membrane from loss of boney tissue prevents the proper wearing of a comfortable denture. The same effect is produced whether the loss is of the upper or the lower alveolar ridge or both.

The primary treatment of fracture of the alveolar process of either the upper or lower jaw resolves itself into replacing the fragments, if attached to the soft tissues, and fixing them to neighboring solid teeth when the teeth are attached. Fragments of bone which are detached should be removed as they will be thrown off sooner or later and will produce inflammation and local reaction until this takes place.

When the teeth are removed by the usual methods, either simple extraction or surgical removal of the alveolar process, the overlying mucous membrane contains much scar tissue, which usually contracts down over the remaining boney surface. But too frequently this does not occur. In the latter case the mucous membrane is loosely attached and rides the low ridge as a soft, flabby, movable, unstable mass of interspersed mucous membrane and scar tissue. This is an unsuitable base for anchoring a prosthesis. A prosthesis resting on such a low foundation is, in fact, like a house built on shifting sand. Mastication is difficult because of the movements of the prosthesis, especially the great lattitude of its lateral motion.

This unfortunate condition may be remedied by what is believed to be an original procedure:

On May 20, 1935, a patient was referred to me for treatment of this condition. He was about 55 years of age and gave the following history: When a youth he was kicked in the face by a horse following which he lost all of his upper teeth and with them the entire upper alveolar ridge on both sides. The mucous membrane hung down from its boney base as a narrow band of tissue which was soft and flabby. It was readily movable and flaccid. The patient had had, during these many years, a great number of dentures but not one was satisfactory, for having nothing firm to grip they moved about in a most disconcerting manner. Under local anaesthesia he was operated upon.

A small incision or nick was made anteriorly near the region of the former location of the central incisors and an instrument was passed so as to form a pocket in contact with the base of the alveolar ridge between the two apposed layers of mucous membrane and extending from near the median line in front outward and

backward to the normal location of the posterior molars. The curve of the boney parts was followed on both sides. A Reverdin perineal

Oregon Medical School. She had had osteomyelitis of the mandible, following fracture, resulting in an external disfiguring scar and
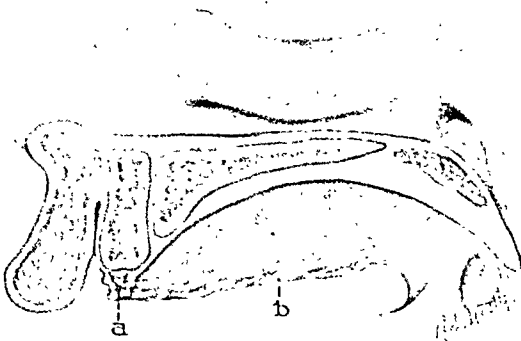
Fig. 1. a, the mucous membrane and its contained scar tissue seen in cross section. b, superficial view of same.

Fig. 2. a', cross-section showing rib cartilage inserted between layers. b', the mucous membrane filled out and "firmed" by the cartilage implant; it will now hold a prosthesis.

needle or similar long curved needle or director may be used for this purpose.

A section was cut from the right fifth rib cartilage, long enough to reach the full lengths of the cavities provided and large enough to fill out the contours snugly between the layers of the reflected mucous membrane. The cartilage graft on the left side was about 4 cm. long with a diameter of about 2 mm. That on the right was a little shorter. These cartilage grafts, slightly pointed, were pushed into place in the prepared cavities and at once the mucous membrane and its submucous tissues became rigid and fixed and hugged the alveolar base firmly. The mucous membrane ridges were now not movable. The minute wounds through which the manipulations had been carried out were then closed. Healing of the small incisions took place within a few days. The patient was returned to his dentist with a high, firm ridge that would hold a plate. A new prosthesis was then made which remained firmly in place and was usable. The patient stated that his mouth was now comfortable for the first time since his accident, that the denture held firmly in place and that he could eat without distress. Four years later the condition was still satisfactory, there being no absorption or change in the cartilage implant.

The second case presented an equally interesting but different condition:

The patient was seen September 14, 1934, at the Outpatient Clinic of the University of

complete obliteration of the lower buccal sulcus on the left side, together with the loss of the six posterior teeth. The floor of the sulcus was on a level with the upper border of the alveolar ridge and it was impossible to fit a denture that would hold its position.

The external skin scar was removed and the wound resutured giving improved appearance. The sulcus was later rebuilt according to the following method:

An incision was made through the crest of a small web at the anterior extremity of the deformity. An instrument was passed between the mucous membrane and periosteum, raising the soft tissues from the latter until a cavity was formed extending back the full length of the normal sulcus. This cavity was enlarged superiorly by incising the submucous tissues, great care being taken that the overlying mucous membrane was not perforated. By this means a cavity was prepared which was sufficiently large to allow the succeeding steps of the operation to be performed. This cavity extended from the periosteum to the submucous layer of the mucous membrane.

The tunnel having been made, a stent or cast of the same was prepared, using dental modeling wax. A Thiersch graft cut from the thigh was then carefully sutured about the wax model with raw surface out, after which the wax model with its skin covering was implanted in the cavity. The wound was then sutured. Twelve days later the superficial sutures were

removed and also the stent. It was then found that a satisfactory long, narrow pocket lined with epithelium had been provided.

FIG. 3. Shows the deep, skin-lined sulcus which will retain a prosthesis.

About three weeks later the roof of this skin-lined cavity was incised thus connecting the new sulcus with the mouth through its full length. This buccal sulcus was deep, long and lined with epithelium. In a few days the overhanging edges retracted and a satisfactory

sulcus had been provided, one which would be suitable for the fitting of a plate or other denture which was later accomplished successfully. This operation also gave a permanent result.

These two operations while quite dissimilar in the procedures carried out, were similar in that they both allowed the fitting of prostheses which had been impossible because of lack of sufficient holding surface. The operations are difficult because of certain technical features involved. Operations within the mouth are always carried out in an infected cavity and must be done with a technic which will keep the mouth secretions out of the wound. The carrying out of this technic is aided by the prone position of the patient and by good visibility of the field of the operation. Under proper conditions the mouth of the wound, in either case, may be approached without danger of contamination. It is important that the grafts be sealed in position in a sterile condition and kept so until healing has been entirely completed.

The importance of these operations is derived from the results obtained in the sense of comfort and well being of the patients and their relief from very distressing conditions.

EXPERIMENTAL STUDIES ON THE SOLVENT ACTION OF ETHER ON GALLSTONES*

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THE idea that gallstones might be dissolved by bathing them in a lipoid solvent is not a new one. In 1901, Walker[1] cited a case in which he used an ether glycerine solution to dissolve a stone by irrigation through a sinus leading to the gallbladder. However, the use of ether for this purpose was not generally accepted, nor was further mention made of it until Pribram[2] recorded its use in the removal of the common duct stone in the bad risk case. Best[3] tells of its unsuccessful use in several cases of remaining common duct stone and gives a method of nonoperative treatment which he considers more efficacious.

In an experimental study on dogs with catheters sutured into their gallbladders and their common ducts tied off, Probstein and Eckert[4] found that their animals objected strenuously to the injection of 3 to 6 cc. of ether; they invariably grew listless; their output of bile decreased; some became jaundiced and all died or had to be destroyed. Microscopic study showed progressive destruction of the mucosal lining of the gallbladder and biliary tract and edema of the hepatic parenchymal cells. The dog surviving for the longest period had daily injections of ether for fourteen days.

In a recent résumé of advances in the surgical treatment of biliary disease, Boyce[5] gives ether credit for being a safer agent than Probstein and Eckert have indicated. He cites a very poor risk with acute pancreatitis and acute cholecystitis and a low liver function test in which the use of ether causes no disturbance.

It had been our impression from an experience with two clinical cases that ether might be valuable as an alternative to re-operation:

One of these cases had been operated upon elsewhere and the gallbladder removed. At a second operation by the same surgeon the common duct presumably had been explored for recurring attacks of chills, fever and jaundice with upper right quadrant pain. The progress of the condition had not been changed by the latter procedure. At our operation the common duct was found to be filled with small stones extending up into the biliary tree. When it was thought that all had been removed and a dilating probe was passed easily into the duodenum, the duct was drained. There followed a postoperative period of chills, fever and an obvious blocking of the duct above the catheter, but a free passage of sodium iodide into the duodenum as demonstrated by x-ray. Three cc. of ether were injected carefully each day and then the catheter was irrigated with normal saline solution. After several days many small pieces of stone, together with purulent bile, were ejected from the catheter and the patient improved. There were several recurrences of this episode with demonstrable blocking of the duct as shown by sodium iodide injection. Each time the injection of ether relieved the condition and finally the entire biliary tree filled with the opaque medium and the patient had no further difficulty. She left the hospital six weeks after operation with the catheter in place and draining clear bile. Six months after the catheter was removed she had experienced no new attack.

The second case had been operated upon for acute cholecystitis. Her surgeons considered her condition too precarious for exploration of her common duct. She was convalescing from an obstructive resection of the splenic flexure for carcinoma when the attack occurred. She

came to our attention when her sinus refused to heal. X-ray revealed three large stones containing calcium, i.e., opaque to roentgen ray.

they will dissolve in approximately one hour. However, if they are impregnated with even a small amount of calcium, the

FIG. 1.   FIG. 2.   FIG. 3.

FIG. 1. Appearance of gallbladder of dog operated five days previously. Thirty stones have been inserted with an ordinary catheter for injection of ether and a Malcotte catheter for the outflow. Twenty per cent sodium iodide solution was used for the radiopaque medium.

FIG. 2. One week later, after daily irrigation with 200 cc. ether. The shadows of the stones are smaller. The gallbladder contains more opaque fluid.

FIG. 3. After two weeks of daily irrigation with 200 cc. ether. The gallbladder shadow is homogeneous. The shadows in the fundus are caused by the fenestra in the Malcotte catheter. Autopsy reveals a few tiny fragments of stones in the head of this catheter.

The sinus tract was gently dilated and a catheter passed down to the nearest stone. After two weeks of irrigation with ether the stone came out of the tract showing definite erosion from the use of the solvent. An injection with sodium iodide solution revealed the location of the other two stones in the common

solubility is greatly decreased. The calcium framework of the stone may remain after the cholesterin is dissolved.

EXPERIMENTAL WORK

For the experimental work fairly large dogs weighing thirty to fifty-five pounds
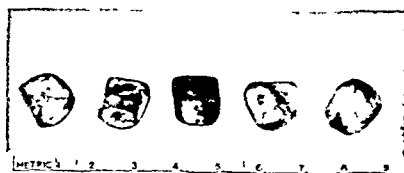
FIG. 4. Gallstones before they were placed in the gallbladder of a dog.
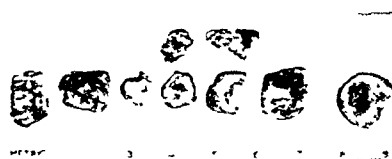
FIG. 5. Appearance of same stones after irrigation daily for a week with 200 cc. ether through a two-way system.

duct. Further treatment with ether gave so much discomfort and had so little apparent effect on the stones that its use was abandoned.

These experiences led us to attempt a study of the solubility of gallstones in vivo. It is a well known fact that only the lipoid solvents, e.g., ether, chloroform, carbon tetrachloride, have any practical value in the rapid solution of cholesterin. Of these, ether is least toxic and probably least irritating. When pure cholesterin stones 1 cm. in diameter are placed in pure ether,

were used. The procedure involved the placing of four or five stones from the same individual in the gallbladder of the dog. They were not opaque to x-ray and dissolved readily in ether as determined beforehand by testing in vitro. Into the fundus of the gallbladder a No. 20 F catheter was sutured. After four days, when the dog seemed thoroughly recovered, 2 to 3 cc. of ether were injected slowly and the pressure was quickly released. The dogs

usually objected to the treatment. Occasionally they vomited immediately after the ether was injected. However, they did not seem to lose their health or weight. The stones did not dissolve readily. Worst, of all, it seemed impossible to keep even a mushroom catheter in the gallbladder. Usually, after a week of treatment with 3 to 6 cc. of ether administered slowly twice a day, the catheter would come out and have to be replaced by re-operation. The size of the stones diminished slowly and it was only after four weeks of treatment had elapsed that they showed almost complete disintegration.

During this first period of our experiment it was noted that our greatest difficulty came with the extreme volatility of ether with the resultant pressure created within the gallbladder during injection. At 38°c. and atmospheric pressure (760 mm. mercury) 1 cc. of ether evaporates to form 222.1 cc. of vapor. This fact makes it imperative that there must be immediate release of this pressure if ether is to be injected into the biliary tract. Anyone who has used ether in attempting to dissolve common duct stones has noted that there is upper abdominal discomfort and pain under the shoulder if the ether is not injected very slowly and the pressure immediately released. Dogs object strenuously to ether injection if the above precautions are not taken.

Therefore, in our last ten animals two catheters were inserted into the gallbladder after the stones had been placed. One of these catheters was no No. 20 F mushroom type, the other was a No. 6 F ordinary type. The stones were approximately 1 cm. in diameter and were pervious to roentgen rays. Through the smaller catheter ether was injected beginning three days after operation. The ether came out of the larger catheter immediately. It was found that the animals were perfectly comfortable at all times during the injection and soon a slow, continuous irrigation was set up. two hundred cc. of ether were used for a single irrigation. Some of the dogs received

one irrigation a day and others two irrigations a day. The only reaction noted in the animals was an occasional first stage
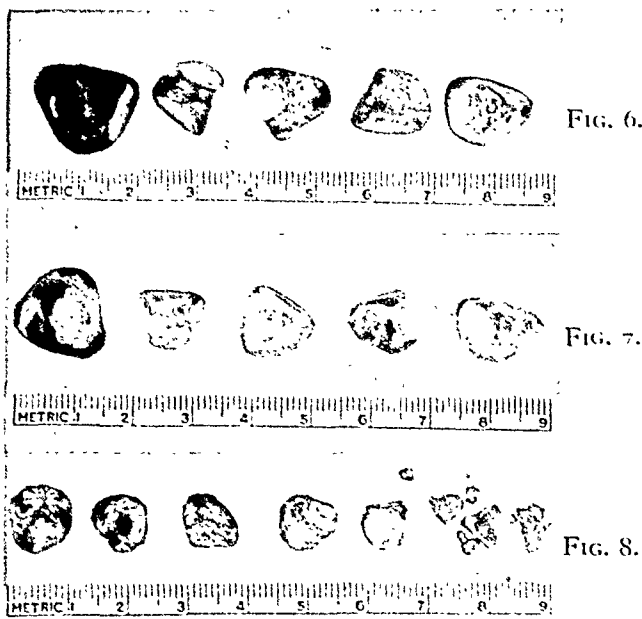
Fig. 6. Gallstones before they were placed in the gallbladder of a dog.
Fig. 7. Same stones after a month in a dog's gallbladder with drainage tubes but no irrigation with ether.
Fig. 8. Same stones after daily irrigation with 200 cc. ether for one week.

anesthesia from the ether which undoubtedly leaked into the duodenum. The dogs ate well and lost very little weight. Weekly x-rays were taken of sodium iodide injection of the gallbladder. After one week of treatment the stones would be approximately half dissolved. They appeared eroded and crumbled easily between the fingers. (Figs. 4 and 5.) After two weeks they had disappeared entirely.

Similar stones and a two-way catheter arrangement were placed in a control animal. After one month the stones had not visibly decreased in size nor had they lost their stony character. (Figs. 6, 7 and 8.) We are aware of the fact that human gallstones dissolve slowly in canine bile[6] but do not believe this need to be taken into consideration because of the time factor.

During each experiment it was noted that there was a free flow of bile from the catheters before and after injection of

ether, and the x-rays showed the cystic and common ducts patent after two weeks of irrigation with 200 cc. of ether twice a day. (Figs. 1, 2 and 3.)

but no ether had been injected. The adjacent liver appeared normal in both dogs.

The gallbladders of dogs subjected to irrigation with 200 cc. of ether twice a day

FIG. 9. Microscopic appearance of cross section of cystic duct of dog after two weeks of injection with 200 cc. ether twice daily. × 120.

FIG. 10. Microscopic appearance of wall of gallbladder of dog used as control with stones and drainage tubes in gallbladder for two weeks. No ether injected. × 120.

FIG. 11. Microscopic appearance of mucosa of gallbladder of dog in which 3 cc. of ether had been injected twice daily for a month. × 120.

FIG. 12. Microscopic appearance of mucosa of gallbladder of dog in which 200 cc. ether had been injected twice daily for a week. All of these sections show only slight infiltration with leucocytes and no damage to mucosal lining. × 120.

At autopsy there was no gross evidence of liver damage. The reaction about the gallbladder was no greater in those gallbladders injected with ether than that about the gallbladder of the control animal in which catheters and stones were placed but no ether injected.

Microscopically, the mucosa proved to be intact even after a month of exposure to ether, 3 cc. twice daily. There was a little cellular infiltration but scarcely more than that seen in the gallbladder of the control animal in which stones and catheters had been in place for the same period

for seven to ten days showed no gross inflammatory reaction. The cystic and common ducts were patent. Microscopically, the mucosa was intact. There was a little infiltration with white blood cells in the submucosal tissues and occasionally a little collection in the muscularis. (Figs. 9, 10, 11, and 12.)

There was no evidence in any of the animals of inflammatory reaction about the gallbladder, ducts or liver sufficiently severe to make a permanent change in the tissue.

CONCLUSIONS

The use of ether in the solution of gall-stones in vivo is a slow process and a dangerous one unless provision is made for its immediate exit from gallbladder or ducts through a two-way system.

There is very little inflammatory reaction in the gallbladder or ducts and the liver is not disturbed by the injection of ether, if the above precautions are taken.

The use of ether in dissolving gallstones will never replace surgical removal but may be quite helpful, alone or in conjunction with the Best treatment, in removing the stone which has been overlooked if it is discovered before drainage tubes are removed.

I am grateful for the co-operation of Dr. Robert K. Brewer, Dr. J. Howard Ferguson and Dr. G. Gowing Broad in preparing this work.

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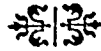
ATLANTO-AXIAL DISLOCATION: REDUCTION BY SKELETAL TRACTION*

REPORT OF A CASE

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MOST injuries to the cervical vertebrae are fractures or fracture dislocations. The vertebrae are so arranged that dislocation without fracture of an articular process or the odontoid process rarely occurs. However, because of the unique anatomy of the atlas and axis, it is possible for them to become dislocated without fracture. This type of dislocation is seldom accompanied by signs of compression of the spinal cord because of the larger dimensions of the spinal canal at this level.

Dislocations and fractures of the cervical vertebrae, with or without injury to the spinal cord, are caused by direct trauma, as in automobile accidents or diving into shallow water, or by indirect trauma, as in suddenly turning the head. Although these lesions are usually traumatic, other types have been reported. Berkheiser and Seidler,[1] among others, reported five cases of spontaneous dislocation resulting from an effusion into the atlanto-axial joints secondary to upper respiratory infection. Coutts[2] had a case of poliomyelitis causing paralysis of the muscles of one side of the neck with subsequent dislocation of the atlas. Brav[3] presented an unusual case of an atlanto-axial dislocation produced voluntarily by the patient.

The incidence of traumatic rotary dislocation of the atlas on the axis is a matter of conjecture, as only a small number of cases appear in the literature. Although most reports consist of isolated cases, larger numbers have been reported by Lang-worthy,[4] three cases, Rankin,[5] nine cases, Coutts,[2] seven cases, Jackson,[6] four cases and Hudson[7] four cases. In 1927, Jackson[6] was able to collect only twenty-seven cases from the literature. Probably the condition is not quite as rare as these figures indicate.

It is the purpose of this paper to report an atlanto-axial dislocation and to call attention to the value of skeletal traction in its treatment as well as in that of other types of dislocation and fracture dislocation of the neck. In the simple uncomplicated rotary dislocation, reduction can be accomplished without difficulty or danger by skeletal traction. Dislocation rarely recurs in these cases if the neck is immobilized for several weeks following reduction.

The mechanism of atlanto-axial dislocation can be more readily appreciated if the anatomy of this region is briefly reviewed. It will be recalled that the atlas and axis are atypical vertebrae. Attached to the superior surface of the body of the axis is the odontoid process. The atlas, which does not have a body, rotates on the axis using the odontoid process as a pivot. The articular surfaces of the paired atlanto-axial joints lie on a nearly horizontal plane. For these reasons, the only important motion which takes place between these vertebrae is rotation. This type of rotary dislocation was described in detail by Corner[8] as early as 1907. If the head is forcefully rotated too far in one direction, it is possible for an articular facet of the atlas to slip off the corresponding facet of

the axis. Such a dislocation is unlikely to occur unless various ligaments and the capsule of the joint are stretched or torn.

Clinically, these dislocations produce a characteristic picture. The head is rotated to one side and locked in this position. The superior facet is usually dislocated anteriorly so that the face is turned away from the dislocated side. The head is cocked slightly to the side of the lesion and the neck is slightly flexed. Muscle spasm causes intense pain, which is increased by attempts at active or passive motion. Definite tenderness pervades the area over the second cervical spinous process. Roentgenograms show that the odontoid process is intact but that there is narrowing of the space between the facets on the dislocated side and widening of the joint space on the opposite side.

We submit the following case of unilateral anterior dislocation (without fracture) of the atlanto-axial articulation:

CASE REPORT

B. B., a colored man, aged 37, was admitted to Charity Hospital in New Orleans, June 18, 1939, following an automobile accident. When he regained consciousness about half an hour after being injured, he complained of pain in the neck and arms. The head was rotated about 45 degrees to the right and locked in this position. He was placed in bed with a four-pound weight attached to a canvas head halter.

Three days after admission, when the authors saw the patient, the head was still fixed in a position of rotation. The patient complained of severe pain in the neck and was irrational. He had been unable to tolerate a heavier weight on the traction apparatus. There was neither weakness of the limbs nor retention of urine. The canvas head halter was removed, and Crutchfield tongs were applied to the skull without moving the patient from bed. A twenty-pound weight was hung at the end of the traction rope and pentobarbital sodium was given. Sometime during the night the dislocation became corrected, and by morning the patient was rational and free of pain. The weight was reduced to four pounds.

Check-up roentgenograms showed proper alignment of the atlanto-axial articulations and

intact odontoid process. In addition, a fracture of the fifth cervical body was disclosed with slight dislocation between the fifth and the sixth vertebrae. Much of the subsequent treatment was directed toward the latter lesion. The head, neck and upper trunk were incorporated in plaster while maintaining the skeletal traction. The tongs were then removed from the skull and the patient gradually resumed walking. The neck was immobilized for nine months. When last examined on April 29, 1940, the patient's neck was still quite stiff and somewhat painful at night, but in view of the multiple lesions he was told to delay physiotherapy until the first anniversary of his accident.

This case demonstrates several features typical of unilateral anterior atlanto-axial dislocation without fracture of the odontoid process. The head was locked in a position of rotation to the right indicating that the upper facet of the atlanto-axial joint had slipped off the lower facet on the left side. It is noteworthy that the canvas head halter traction not only made the patient extremely uncomfortable but did not accomplish reduction. The dislocation was reduced without discomfort within twelve hours after application of the Crutchfield tongs.

Because of the simplicity of application, the comparative comfort of the patient, the rapidity with which reduction is accomplished and the uniformly good results, we believe that skeletal traction, using the Crutchfield tongs, is the ideal method of treating atlanto-axial dislocations as well as most other dislocations or fracture dislocations of the cervical spine. Open operation is rarely indicated except to relieve delayed cord symptoms. This method of traction has been practiced exclusively on the Tulane Neurosurgical Service since January, 1938. It obviates the necessity of repeated readjustments of a canvas head halter and prevents pain and pressure sores under the chin, which the latter may produce. The older treatment of manual reduction described by Walton[9] in 1893 and Taylor[10] in 1924 is potentially more dangerous because of the possibility of

injuring the cord and should be used only by an experienced individual. As late as 1937 Stookey[11] advocated treating dislocations in this way.

forty-three patients treated in this way. Of this number, fourteen died from spinal cord or associated injuries. Twenty-seven of the remaining twenty-nine were treated either
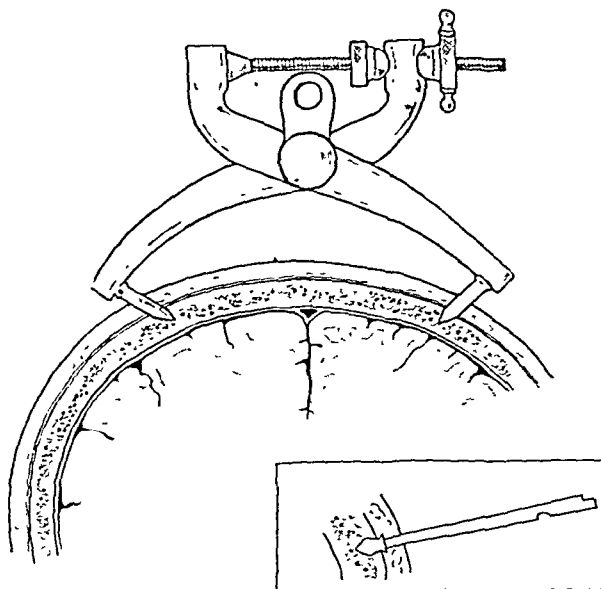
FIG. 1. Crutchfield tongs in place. Insert shows flanged drill which determines depth of hole.
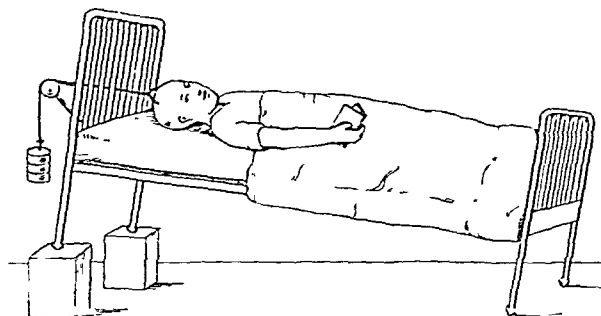
FIG. 2. Head of bed is elevated to provide countertraction.

According to Crutchfield,[12] skeletal traction for reduction of fracture dislocations of the cervical spine was conceived by Coleman,[13] who first used it in his clinic in 1932. Since then, several types of skeletal traction for broken neck have been employed by McKenzie,[14] Hoen,[15] Cone and Turner,[16] Barton[17] and Gallie.[18,19] Other advocates of skeletal traction are Voris[20] and Platt.[21] In 1933, Crutchfield[22] used a modified Edmonton extension tong for this purpose. He perfected his tongs[23] in 1936, reporting excellent results with their employment.[12 24] By 1938, he[25] had a series of

immediately or within two months of injury with partial or complete reduction in every case.

The application of the Crutchfield tongs is so simple that it may be done with the patient in bed. (Fig. 1.) The top of the head is shaved and cleaned with iodine and alcohol. Working between the bars of the bed if necessary, the surgeon presses the middle bar and the points of the tongs against the scalp until two dimples have been produced. These marks should be in the coronal plane of the ears. A stab wound is made in each dimple after the injection of

a little novocain. Holes are then drilled at right angles to the surface of the skull. A flange on the drill prevents the possibility of making openings more than 3 cm. deep. The points of the tongs are fitted in place and locked with a set screw. An antiseptic dressing is applied around the prongs. The application of the apparatus does not require more than five minutes. A weight varying from fifteen to thirty pounds is used for traction and the head of the bed is elevated about twelve inches to provide countertraction. (Fig. 2.) Reduction of the dislocation occurs within a few hours and can be verified by examination with a portable roentgen-ray apparatus. The amount of traction may then be reduced to a few pounds. If there is no cord injury, the neck may be immobilized in plaster immediately. If some degree of paralysis is present, it is desirable to leave the tongs in place for several days or weeks. They should be tightened frequently. If signs and symptoms eventually indicate that the cord has been transected, there is no need for further traction nor immobilization.

SUMMARY

1. The anatomy of the atlanto-axial articulation is briefly reviewed.

2. A case of unilateral anterior atlanto-axial dislocation (without fracture) successfully reduced by skeletal traction is reported.

3. Reduction of all types of fracture dislocation of the cervical spine by skeletal traction is advocated.

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PARTIAL AMPUTATION OF THE PENIS

A MODIFICATION OF THE STANDARD TECHNIC FOR VENTRAL GROWTHS

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THE proper management of carcinoma of the penis is usually influenced as much by the wishes of the patient
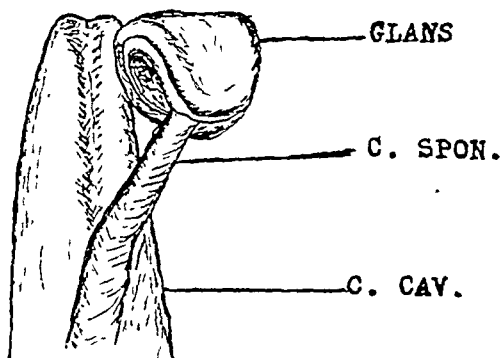
FIG. 1. Dissection of penis, showing anatomical continuity of glans with corpus spongiosum. (From Morris' Human Anatomy, p. 1291. Philadelphia, 1925. P. Blakiston's Son & Co.)

as by the desires of the physician. The results thus becomes a compromise between radical surgery and "noli me tangere." Schreiner,[1] reviewing sixty cases, employed radical amputation and deep therapy as the method of choice; however, the resultant mutilation is abhorrent to the average patient. Dean[2] believes that conservative surgery effectively removes the disease when combined with proper radiation; this view holds with most writers on the subject.

The patient with penile cancer is primarily interested in preserving as much of the organ as possible, even though he imperil his life by so doing. Any operation, therefore, should plan on removing only tissue grossly involved by neoplasm. Pfahler and Widman[3] advocate electrocoagulation of the tumor combined with irradiation and reported 90 per cent of cures. They are of the opinion that irradiation alone, except in very early cases, is not sufficient.

There are certain disadvantages to electrocoagulation: (1) a relatively long period of slough, granulation and regeneration; (2) uncertainty as to the extent of the deeply coagulated tissue, and (3) uncertainty as to the final appearance and function of the organ. Surgery offers a quicker, cleaner and surer result, after the desired amount of irradiation has devivified the cancer cells. Barringer[4] believes that poor results in the past have been due generally to insufficient roentgen treatment rather than insufficient surgery.

DISCUSSION

The standard surgical technic for hemiamputation is aimed at replacing the meatus in its normal distal position. The older textbooks of surgery teach a circular skin incision and a transverse cut across the three bodies of the shaft. Young[5] and Horsley[6] dissect the corpus spongiosum free for a distance of 1 or 2 cm. beyond the amputated corpora cavernosae and cut the stump of the urethra diagonally. Shivers[7] advocates a like dissection, but splits the under surface of the urethra to form a triangle of mucosa at the end of the penis.

Carcinoma of the penis involves the corona of the glans primarily and the usually adherent foreskin. When on the dorsum, the corpora cavernosae may be invaded by contiguity, and the above operations are applicable. However, when the ventral surface is involved, and spread by continuity from glans to corpus spongiosum is insured, the corpora cavernosae would have to be sacrificed much more proximally than demanded by the site of the tumor if the urethra is to be amputated short of the growth yet longer than the

corpora. Figure 1 demonstrates the anatomic continuity of glans and corpus spongiosum.
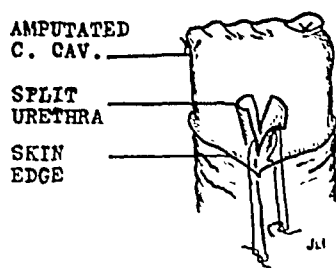
FIG. 2. Tumor area excised. C. cavernosae oversewn and urethra split. Skin suture begun.

There is another factor to be considered, that of the effect of x-rays on tissue. After intensive therapy, degeneration and inflammation are common, and healing without contraction depends on delaying the operation until the worst of the reaction has subsided. Even then, some shrinking occurs; and if this be about the meatal opening, stricture of unpleasant proportions impends. This has happened in two cases on the genitourinary service of the Easton Hospital. Young reports only one such case, and Shivers has never had it happen. Thus the practice of cutting the urethra at a different level than the corpora and angling or splitting the end as mentioned above are improvements in the older technic which eliminate constriction.

In the following case, two conditions, i.e., neoplastic involvement of the *ventral* portion of the glans, and degeneration and inflammation secondary to roentgen treatment were met with and handled in a manner satisfactory to both patient and surgeon. The modification of the standard procedures furnishes the basis of this report. The principle is that of *proximal* amputation of the urethra to form an artificial hypospadias, and the creation of a large rectangular suture line at the mucocutaneous junction.

OPERATIVE TECHNIC

A tourniquet is applied to the base of the organ and the skin reflected; a racquet in-

cision, with its long dorsal flap is possible because of the situation of the growth. An Ochsner clamp is placed over the corpora
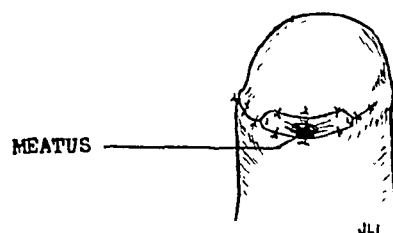
FIG. 3. Operation completed. Dorsal flap of racquet incision covers stump. Arms of split urethra are incorporated in suture line.

cavernosae 1.5 cm. proximal to the corona and the distal portion is severed beyond this. The urethra and attached glans are

FIG. 4.   FIG. 5.

FIG. 4. Amputated area, showing lack of scar contraction one year postoperatively. Arms of split urethra can be seen in vertical position.

FIG. 5. An 18A (26F) sound in meatus, showing free passage.

dissected free from this point for a distance of 3 cm. and cut across midway to complete the amputation.

The urethra is split completely to form two mucosal arms; in this case the split was coronal. Figure 2 shows a sagittal cut, which subsequently seemed more logical, and has been used on a later case. The corpora are oversewn, the tourniquet removed and the skin closure made. (Fig. 3.)

Figure 4 shows the operative site more than one year later. The patient has all uses of his organ and has no complaints concerning his mild hypospadias. The meatus readily admits a 26F (18A) sound, and seems to be increasing in diameter with the passage of time.

CASE HISTORY

A. P., a white male, age 42, was first seen December 17, 1937, complaining of a mass at the end of his penis. This consisted of hard, friable tissue involving the right side of the glans, the adjacent prepuce, infiltrating the urethral area, and increasing the head of the penis to approximately twice its normal size. Biopsy proved this a squamous cell carcinoma, grade II. There was very slight right inguinal adenopathy.

High voltage x-ray to the local tumor and the inguinal glands was given by Dr. Homer Blaser of the Easton Hospital, and consisted of 12,000 r to the penis and 3000 r to each groin in less than two weeks. Fourteen months later he received an additional 5250 r over both groins, given by Dr. George Pillmore. All was administered by the Coutard method.

The early, intensive radiotherapy resulted in a raw, poorly epithelialized surface over the tumor. Part of this was eliminated by circumcision June 20, 1938, when the electrocutting knife was used; good healing was never achieved. Meatotomy was performed November 16, 1938, because of scar contraction, and had to be done at shorter intervals during the next few months.

Meanwhile, a purulent prostatis developed, causing the patient to feel further below par than at any time. After consultation with Dr. Roscoe Teahan, of Jeanes Hospital, Philadelphia, amputation was done by the above method, and several glands of the right inguinal area removed.

A section of tissue removed both in June, 1938, and February, 1939, showed no evidence of neoplasm. The patient has been well apparently to date.

SUMMARY

1. Judicious combination of intensive radiotherapy and conservative surgery is the best treatment for the average case of cancer of the penis.

2. The classical operation of hemi-amputation will occasionally destroy more good tissue than is required by the inroads of the tumor.

3. A modification of technic for such cases, i.e., ventral growths, is suggested; a case is presented using this method.

4. Proximal amputation of the urethra and formation of an artificial hypospadias is the basis of the modification.

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COMPLETE DISLOCATION OF THE KNEE JOINT*

A REPORT OF SIX CASES WITH END RESULTS

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AND

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A COMPLETE dislocation of the knee joint is a rare lesion to which, undeservedly, little critical attention has been paid. Ritter failed to find a single case among 23,000 accident cases at Reconstruction Hospital, and but three cases in the records of the New York Postgraduate Hospital. There are sporadic reports of isolated cases with no follow-up reports, scattered throughout the literature. Conwell and Alldredge reported seven cases with end results in 1937, the first study of this kind. Over a thirteen-year period, we have collected and analyzed from the records of the Metropolitan and Flower-Fifth Avenue Hospitals six cases of complete dislocation of the knee joint without complicating fractures. We believe that while these case reports may not be a new departure in the field, they are a definite contribution to the knowledge of treatment and sequellae.

It is inevitable that the ligamentous structure and the capsular apparatus of the joint should be severely torn, leaving the replaced knee temporarily unstable. The treatment revolves on the anatomic replacement of the bony alignment and a ligamentous repair. A study of the literature in this regard is confusing; advocates of immediate suture-repair of the torn ligaments are equally numbered with those of the more conservative school. The excellent results that we have obtained with our conservative treatment substantiate that of Conwell and Alldredge. The immediate treatment of choice is not a stabilizing operation, but closed reduction, preferably under general anesthesia.

The use of general anesthesia depends upon the elapsed time and the co-operation of the patient, but the important consideration is an immediate replacement when seen by the physician. Five of our patients were treated with a plaster cast for from three to five weeks; two had traction for fractures of the leg (not involving the knee); and one patient had an exploratory operation. No patient had a plastic repair or a suture-repair of the lacerated ligaments. All of the cases had good results. Cubbins, Callahan and Scuderi have described a method of repair for cruciate ligament injuries. In our opinion there is no indication for this until conservative methods have failed and certainly not until the second year of treatment.

ANATOMY

Of the structures stabilizing the knee joint, the following are important: (1) the cruciate ligaments, (2) the tibial and fibular collateral ligaments, (3) the semilunar cartilages and (4) the capsule and surrounding muscles. The cruciate ligaments are anterior and posterior. The former prevents hyperextension of the knee and anterior displacement of the tibia; while the posterior prevents posterior displacement of the tibia, being taut when the knee is flexed. Complete dislocation of the knee causes a complete rupture of one or both of these structures depending upon the direction of force, and this leads to antero-

posterior instability. The collateral ligaments prevent lateral mobility of the knee. These are torn in a complete lateral

FIG. 1. Anterior complete dislocation of knee; lateral x-ray view.

dislocation. Fractures of the semilunar cartilages are uncommon in complete dislocations. Operative intervention would, of course, be necessary in such an event.

CASE REPORTS

CASE I. H. M., age 18, a male, truck helper, jumped from a speeding truck and was run over by another car He was admitted at once to the Metropolitan Hospital on August 25, 1937, with a diagnosis of complete anterior dislocation of the left knee, with rupture of the anterior cruciate and both collateral ligaments, comminuted fractures of the middle third of both femurs, fracture of the internal malleolus of the left ankle and traumatic shock. Due to his poor condition, the dislocation was reduced on the ward by traction and manipulation without general anesthesia. Physical examination

revealed hyperextension of the left knee joint with increased lateral motion. The tibia slid forward on the femur very easily. Russell

FIG. 2. Same as Figure 1; anteroposterior view.

traction was applied for treatment of the femur fractures, until October 6, 1937. The patient was up on crutches on October 10 and left the hospital on October 20, 1937. He was seen at the follow-up clinic on December 17, 1937. At this time there was no limited motion at the hip, knee or ankle. On January 19, 1938, the patient complained of a slight buckling of the left knee once or twice a day. An elastic knee support was prescribed. The patient was last seen on March 4, 1938. At that time, physical examination showed no lateral motion and there was no limitation of function. He had resumed his former occupation as helper on a milk truck several months previously. The knee joint no longer buckled.

CASE II. E. R., a male, white, accountant, 63 years of age, was struck by an automobile on the lateral side of the right knee on the day before admission. The ambulance surgeon

found a complete lateral dislocation of the right knee which he reduced. He was admitted to the Flower-Fifth Avenue Hospital on September

was lacerated for two inches. On opening the latter, the semilunar cartilages were intact, but the cruciate ligaments were completely torn at
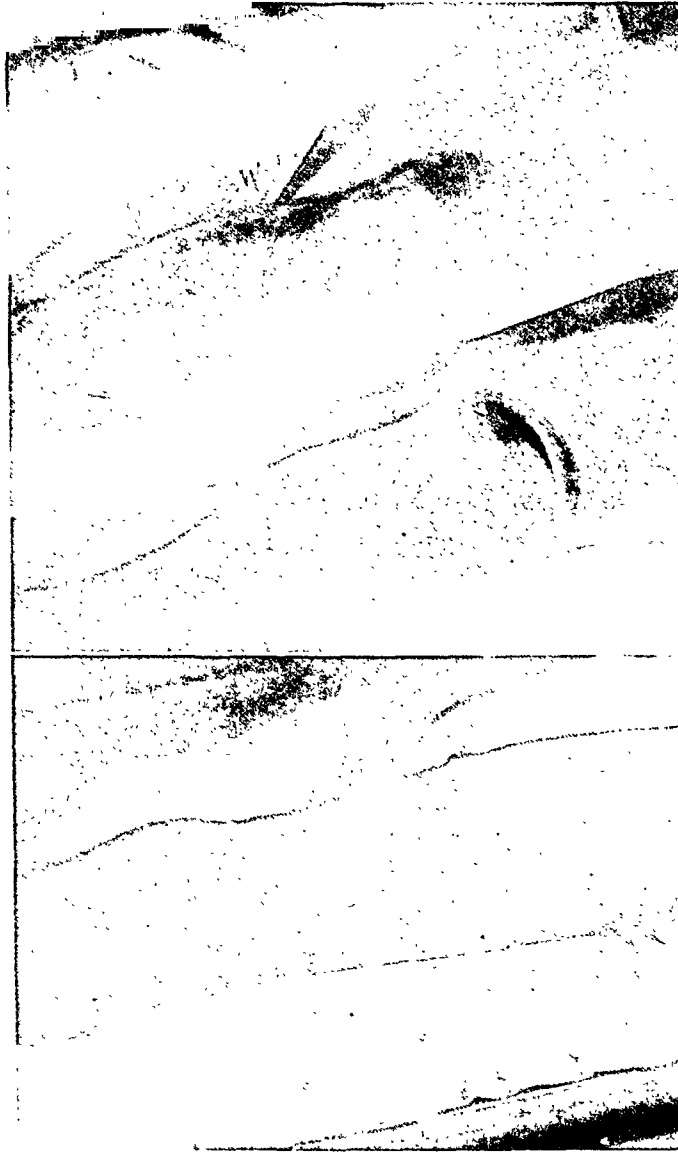
Fig. 3. Photograph of both legs, anteroposterior view showing complete anterior dislocation.

Fig. 4. Lateral view of same patient shown in Figure 3.

27, 1934, with a diagnosis of complete lateral dislocation of the right knee, laceration of the capsule, and laceration of the right medial collateral and the cruciate ligaments. Physical examination revealed a massive effusion into the joint with an ecchymosis over the inner aspect of knee. This was soft, fluctuant and painless. The patient had no pain or tenderness on admission. The knee could be completely subluxed at will. The x-rays were negative for fracture. On September 27, 1934, the patient was given a general anesthetic and the knee joint explored. The internal lateral ligament was found to be completely torn. The capsule

their insertions. The wound was irrigated and the capsule sutured with chromic catgut No. 2. The skin was closed with black silk. A circular cast was applied from groin to ankle. On removal four weeks later, physiotherapy was started at the clinic. When seen on September 21, 1939, the patient had been working for three years without any difficulty with the knee. There was no lateral or anteroposterior instability and no limitation of motion at the knee.

CASE III. M. W., 23 years of age, a male, chauffeur, slipped and fell on the right knee while intoxicated. He was admitted to the

Metropolitan Hospital on December 25, 1925. On physical examination, the right knee was painful on motion in all directions. The condyle

right tibia was displaced anteriorly on the femur. The patella was intact. Crepitus and abnormal motion were elicited over the mid-

FIG. 5. Anteroposterior view of x-ray showing knee reduced. Note that there are no fractures.

FIG. 6. Lateral view of same patient shown in Figure 5.

of the tibia was displaced backward with distention of the posterior popliteal fossa. The diagnosis made was complete posterior dislocation of the right knee. Reduction was performed under general anesthesia by means of traction and manipulation. A circular cast was applied from the groin to the ankle. This was removed in three weeks and the patient walked without disability. He was discharged one week later, asymptomatic and in apparent good condition. Examination made three months later of the right knee showed good anteroposterior and lateral stability with unlimited function and no pain. The patient had returned to his former occupation one month before.

CASE IV. F. S., a male peddler, 22 years of age, was struck from behind by an auto and was admitted to the Metropolitan Hospital on August 8, 1936, with a diagnosis of complete anterior dislocation of the right knee, comminuted fracture of the middle third of both bones of the right lower leg, transverse fracture of the upper third of the left fibula, cortical incomplete fracture of the upper third of the shaft of the left femur and catarrhal jaundice. Physical examination revealed inability to move the knee or hip joint of both limbs and inability to lift either heel from the bed. The

shaft of the right lower leg. Under general anesthesia, the dislocation was reduced and a Steinman pin inserted through the os calcis for skeletal traction of the leg fracture. On September 14, the traction was discontinued and a plaster cast applied from groin to toes (right leg). The cast was removed on October 21. One plus motion was found at the fracture site. Despite stiffness of the knee found at this time, it was necessary to incorporate it in the new cast because of the fracture. A bone drilling for delayed union was done on December 10, 1936, and a plaster cast reapplied. In March, 1937, the last cast was removed. The patient was seen again in the follow-up clinic two years later on December 10, 1938. He had been driving a milk truck regularly since August, 1938. There was one inch atrophy of the muscles of the right thigh. Flexion of the knee was possible to 105 degrees and there was no lateral motion. The right tibia could not be displaced upon the femur. The right knee joint was painless.

CASE V. W. M., male laborer, colored, 35 years of age, stepped off a curb and twisted his left knee inward. He was admitted to the Metropolitan Hospital on November 18, 1931. Physical examination revealed the left knee to be slightly swollen and tender with exquisite

pain on attempted motion. A diagnosis of complete medial dislocation of the left knee was made and confirmed by x-ray examination. Reduction was obtained by traction and manipulation under general anesthesia and a plaster cast was applied from the groin to the ankle. The patient was discharged on December 23, 1931, after having had the cast on for four weeks. On leaving the hospital, he had no lateral motion, no pain or tenderness and no limitation of function in the left knee. He was seen one month later in the follow-up clinic and was ready at that time to return to work.

CASE VI. P. S., 21 years of age, a male, laborer, was asleep as a passenger in the front seat of an automobile which collided with another car. He was admitted to the Metropolitan Hospital on November 5, 1937, with a diagnosis of complete anterior dislocation of the left knee, rupture of both cruciate ligaments and of the medial collateral ligament. Physical examination revealed the knee fixed in full extension, and the calf in a plane with the anterior surface of the thigh. The upper end of the tibia could be palpated anteriorly. The skin of the popliteal space was tense, but the hamstrings and the femoral condyles could be palpated. The dislocation was reduced under intravenous evipal and a circular cast applied from groin to ankle the same day. The patient was discharged on crutches with the cast in place on November 12, and readmitted November 27, after he had fallen down, broken the cast and partially redislocated the knee. A new cast was applied and the patient discharged. He was not seen until one year later. At this time he had complete use of the knee with no lateral motion and no anteroposterior displacement. There was no limitation of function and no pain. The patient had returned to work several months before. (In the interim the cast had been removed in the clinic and physiotherapy treatments had been given.)

SUMMARY

1. Six cases of complete dislocation of the knee joint are presented with end results. No patient had a plastic repair. One patient had an exploratory operation, but the wound was closed when the semilunar cartilages were found to be intact. Two patients were treated with traction due to fractures of the upper or lower leg but not involving the joint. Five patients were treated with plaster casts. All were seen early and reduced immediately.

2. Four patients had a general anesthesia. One did not because he was in shock.

3. Three were cases of anterior dislocations; one was lateral, one medial and one posterior.

4. Five patients ranged from fifteen to thirty-five years of age. One was sixty-three years old and all were males.

5. All the dislocations were complete. Each had a good result on leaving the hospital and in the follow-up period, with spontaneous repair of the internal ligaments of the knee.

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LINGUAL THYROID*

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IN the process of fetal development the thyroid gland is developed from a median diverticulum which appears about the fourth week on the summit of the tuberculum impar, but is later found in a furrow immediately behind the tuberculum. It grows downward and backward as a tubular duct, which bifurcates and subsequently divides into a series of cellular cords, from which the isthmus and the lateral lobes of the thyroid gland are developed. The connection of the diverticulum with the pharynx is termed the thyroglossal duct, its upper end being represented by the foramen cecum of the tongue and its lower by the pyramidal lobe of the thyroid gland.[1] The thyroglossal duct is divided into upper and lower portions, the lower extending from the hyoid bone to the pyramidal lobe of the thyroid gland. While the thyroglossal duct usually passes behind the hyoid bone, it may be situated in front of or pass through the substance of the bone itself, a condition made possible by the later fetal development of the hyoid bone. These various courses of the duct justify consideration of the surgical treatment of conditions involving the tract.

Not infrequently does the thyroglossal duct remain patent from the isthmus of the thyroid to the foramen cecum. With faulty descent of the thyroid from its site of origin the gland may be situated, in whole, or in part, anywhere along the course of the duct. (Fig. 1.) When this occurs at the foramen cecum, it results in the development of a lingual thyroid. Portions of the gland may be arrested in its descent in the substance of the tongue producing an intralingual thyroid or at its base where a sublingual thyroid is formed. A prelaryngeal thyroid is seen when this process takes place in front of the larynx below the hyoid bone. Going downward the gland is next found in its normal situation anterior to the cricoid cartilage and the upper tracheal rings. Finally, there may be additional masses of thyroid tissue in the retrosternal area, located in the superior mediastinum, as a result of the downward projection of cells from the gland in its normal situation.

Since 1866[2] there have been reports of tumors seen on the posterior surface of the tongue which have been accepted as lingual thyroids. Dr. M. Lawrence Montgomery[3] reported 144 cases gathered from the literature between 1888 and 1935. Bronson S. Ray[4] after a complete study of the reported cases states that there are about 250 cases in the literature. The rarity with which a lingual thyroid is encountered added to an unusual interest in this lesion and stimulated by the fact that we recently cared for such a case, prompts the submission of this report to surgical literature.

It is self evident that this type of thyroid is existent from birth. The greater percentage of the reported cases occurred in females and were brought to the patient's attention by the physiologic enlargement of the gland associated with puberty and in some cases during pregnancy. Some female patients noted a definite enlargement of the lingual thyroid during menstruation. Enlargement also followed operations for ovarian cysts.[5] Following thyroidectomy there has been a compensatory enlargement of the accessory lingual thyroid.[6] In

younger patients, if the gland on the tongue is small, it may be accidentally discovered, or if increasing in size, may so interfere

of the cases the thyroid in the neck is absent, a fact, which calls for consideration before surgical treatment is instituted.
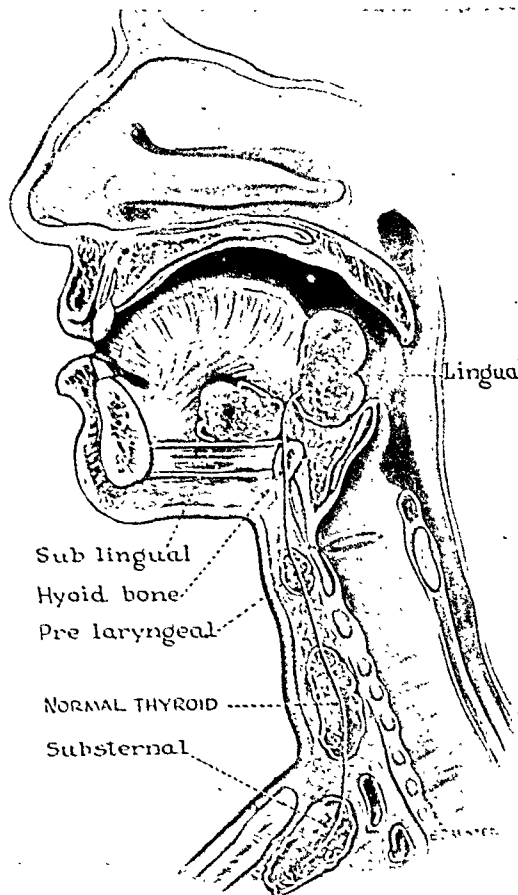
FIG. 1. Shows the various locations of the thyroid gland and also the abnormal locations of thyroid tissue.
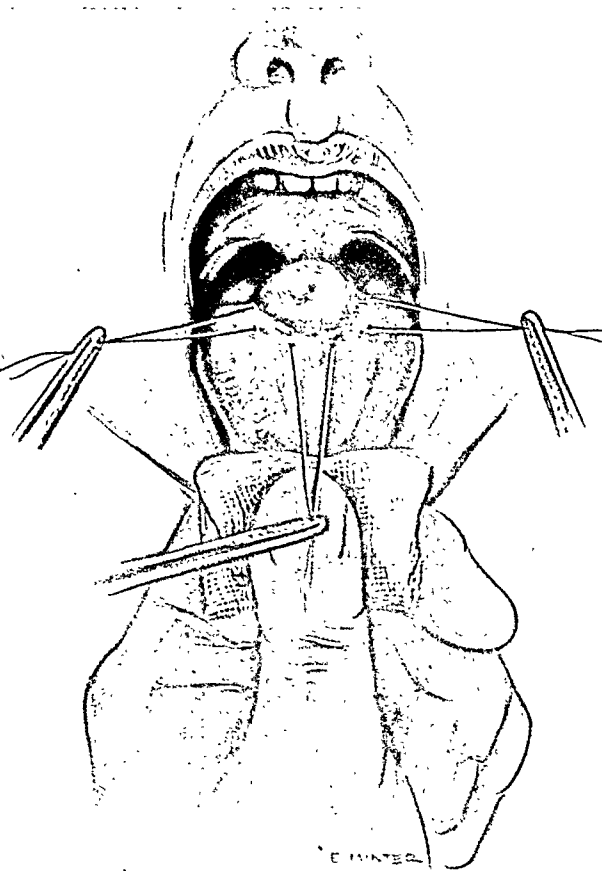
FIG. 2. Shows the method of exposure of a lingual thyroid gland and the scheme for control of hemorrhage.

with swallowing as to impair nutrition. Dyspnea may be an outstanding complaint or there may be a disturbance in phonation.

Grossly, the lingual thyroid is seen to be situated in the midline of the tongue, anterior to the epiglotis and in the region of the foramen cecum. It is found to be a single tumor, covered by the mucosa of the tongue with a smooth or lobulated surface and somewhat globular in shape. It usually possesses a broad base through which it receives a copious blood supply to influence the color of the gland which may be anything from a light pink to a deep red. Cases are reported in which the lingual thyroid has been found at the end of a pedicle.[7] These tumors may vary in size, being as small as a pea or large enough to fill the pharynx. It is reported that in 70 per cent

The lingual thyroid usually is found to give a histologic appearance of normal thyroid tissue. But the growth may be affected and show any of the changes seen in the thyroid in its normal situation, such as, cysts, adenomas or malignancy. If the secretory function of the gland is altered, its host may exhibit a clinical picture seen under such conditions. Toxic symptoms from hyperactivity occur and, on the other hand, cretinism and myxedema have been seen. These conditions, however, are in the minority.

It is easy to understand that there may be no symptoms associated with this condition, particularly, if the growth is small. If the growth is larger, it is so located as to be traumatized frequently during deglutition and give rise to hemorrhage which Bronson

S. Ray[1] states occurred in varying degrees in 10 per cent of the cases reported. The patients complain of a fullness in the throat and difficulty in swallowing, breathing and talking. Following trauma there may be ulceration and occasionally pain and the breath may have a fetid, offensive odor.

Before surgical removal of the lingual thyroid is effected the existence of other thyroid tissue should be confirmed. Since palpation of the normal gland in the neck is sometimes very difficult, exploration of the neck can be done quickly and with safety. Extirpation of the lingual thyroid is justified when there is enlargement sufficient to interfere with breathing, speaking or swallowing, hemorrhage, degeneration and necrosis, hyperthyroidism which does not yield to medical treatment and in cases in which malignant change is suspected.

In the absence of other thyroid tissue subtotal removal of the lingual gland has been suggested. This has been done in a number of instances and the incidence of recurrence is small. However, if the entire gland is removed the patient's needs can be satisfactorily met by the administration of thyroid extract, the dosage being determined after periodic elicitations of the basal metabolic rate. This latter test should be done before operation and at regular intervals thereafter. Attempts to transplant some thyroid tissue have not been highly successful. It is difficult to remove tissue from such an infective area as the mouth and obtain a successful graft.

CASE REPORT

A girl, three and one-half years old was referred to us by Dr. Ralph Venturo, Glassboro, New Jersey. Her parents had discovered a lump in her mouth in the first week of January, 1940, upon looking down her throat after she had been hoarse for a number of days. She was undernourished and small for her age. Before her parents discovered the growth the child would say, "Mamma, I have throat" in an apparent effort to say that she had something in her throat. From the time she was able to talk she would complain that anything even if lukewarm was too hot. The child was taken

to several physicians who made no specific recommendations. The mass enlarged rapidly during the two weeks preceding admission, hoarseness became more pronounced, vomiting occurred several times and the child was noticeably more nervous. She was admitted to the Brewer Hospital, Woodbury, New Jersey, and operated upon February 22, 1940. Ether anesthesia was used. The child was discharged three days later and made an uneventful recovery. A basal metabolic rate was done on March 16, 1940, and was $-n$?o. Thyroid extract—gr. 1—daily, was given and the B. M. R. repeated on April 26, 1940, showed it to be -12. The first month after operation she gained two and one-half pounds. Her nervousness had diminished, she can now tolerate hot foods, swallowing is not disturbed, hoarseness is absent, she makes no reference to anything in her throat and she is assuming the appearance of a normal girl of her age The last B. M. R. done on May 28, 1940, was $-$-.

Operation. Under deep ether anesthesia, using an ether tip and a tonsil suction apparatus a transoral operation was done. The jaws were held open with a Davis mouth gag. Following a procedure patterned essentially after Lahey's method[5] the tongue was grasped between the fingers and pulled well forward. Sutures of No. 1 chromic catgut were inserted into the tongue lateral to the growth and anterior to it in the midline. (Fig. 2.) Traction was made on these sutures to deliver the growth further and to control hemorrhage. The mass was then excised with an elliptical, wedge-shaped incision Bleeding points were clamped, ligated and the edges approximated with mattress sutures. Convalescence was uneventful.

Pathologic Examination. "Grossly, the specimen consists of a small tumor mass 2.5 cm. in diameter. It is covered on one side by smooth, glistening epithelium which contains a few papillae. There is one depression which leads to a blind duct, measuring about 2 mm. long. The tumor itself is light brown, moderately firm, glistening, somewhat gelatinous and with a tendency to cyst formation."

Histology. "Section consists of a small piece of tissue from the base of the tongue. It is a fairly well circumscribed nodule and is characterized by a number of acini. These acini are filled with colloid. The lining epithelium is low cuboidal in nature, the colloid is deep staining. In other areas there is considerable mucinous-

like tissue and some hyperplasia of the lining cells. In some instances, the cells are swollen and filled with colloid like material."

Diagnosis. "Aberrant thyroid tissue."

SUMMARY

1. Another case of a lingual thyroid is reported to surgical literature.

2. Before the surgical removal of a lingual thyroid is effective the existence of other thyroid tissue should be confirmed. However, if the entire gland is removed, the patient's needs can be satisfactorily met by medical therapeutic measures.

3. A transoral operation for the removal of a lingual thyroid is described.

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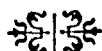
Correction: It was erroneously stated on page 11 in our January issue that Dr. Meredith F. Campbell was President of the American Urological Association. It should have stated that he is President of the New York Section of the American Urological Association.

MODIFICATION OF THE MUNRO TIDAL DRAINAGE APPARATUS*

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WHEN Munro first presented his conception of tidal drainage of the urinary bladder in 1934, it apparently was not evident to the urologists discussing the paper that this method of treatment had urologic significance. However, it was soon discovered that this was a valuable and dependable addition to their therapeutic armamentarium, and modifications of the original apparatus for special cases were devised.

We wish to present two such modifications: the first having very general application and the second a very limited one. Tidal drainage was first utilized by the urologist for the treatment of cystitis, particularly in those obstinate cases which did not respond to recognized measures. The value of the treatment lies in the regular, automatic distention and irrigation of the bladder. With the original apparatus, the reservoir and tubing had to be filled at each cycle before any fluid entered the bladder, and the evacuation of the viscus was sometimes incomplete. It was evident that with constant irrigation the modality would be more effective. For this purpose, the modification shown in Figure 1 was devised. Essentially, it consists of a two-way catheter with tidal drainage apparatus attached to the outflow. All the fluid entering the apparatus must first pass through the bladder. Actual tests have shown that a solution of indigo carmine will be cleared from the bladder in half the time that is required with ordinary tidal drainage. This modification is valuable in the treatment of all types of cystitis, but particularly so when the urine is markedly infected or when incrustations are present, and per-mits the use of any of the medicinal solutions now in use.

DESCRIPTION OF APPARATUS

The fluid is placed in the container, A, from which its rate through the dropper, C, is controlled by clamp, B. It then flows to the intake of a two-way catheter, D. Fluid leaves the bladder by the outflow of a two-way catheter, E, and flows into the reservoir, G, through a small glass tube, H. After the reservoir is full, the fluid will rise in the vent, F, and siphon arm, I. When the intravesical pressure is greater than that in the siphon arm, siphonage takes place, emptying both the bladder and reservoir into the waste bottle, J.

Because the reservoir, G, is drained by a smaller tube and is lower than the bladder, it will empty more slowly than the bladder. When the reservoir, G, is empty, air will be drawn through the air vent, F, thus breaking the siphonage and permitting the filling cycle to recur.

When assemblying this device, care must be taken that the reservoir is lower than the patient, and that it is drained by a smaller tube than that draining the bladder. This is to insure emptying of the reservoir after the bladder is empty. Also, the apparatus will work better when the tube connecting the bladder to the reservoir is on a gradual downhill slant.

Cystometrograms will be found superfluous if this apparatus is started in the following manner: The siphon arm, I, is raised considerably above its final expected level and dropper, B, so adjusted that the fluid is running at the desired speed, usually sixty to ninety drops per minute. When the

fluid in the air vent, F, reaches the level of the bladder, a marker is placed on the reservoir, A. The fluid is permitted to
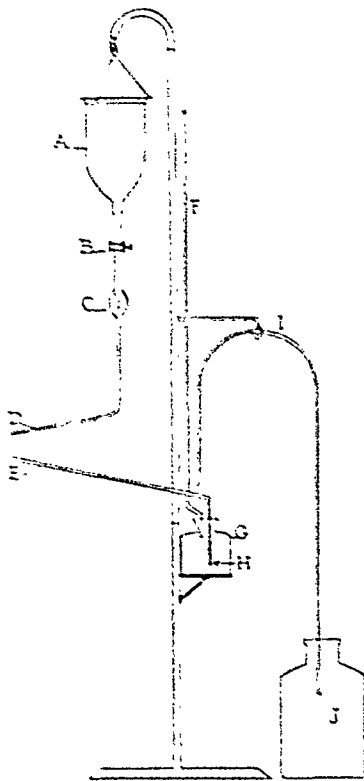
Fig. 1. Schematic drawing of tidal drainage apparatus with lead D to and exit E from the two-way catheter in bladder.

flow and readings taken at each 50 cc. until the bladder capacity is reached. In the average, this is about 300 cc., but in many diseased bladders, it may be considerably less or more. To institute treatment, the siphon arm is lowered to the level where the siphon will work and it is fixed there. As the bladder capacity improves, the siphon arm will require readjustment. The strength of the detrussor muscle and restoration of normal bladder function is accelerated by increasing the pressure slightly.

The second modification, shown in Figure 2, consists of an apparatus to instill a measured amount of fluid into the bladder and withdraw it immediately. Practically, this apparatus is limited to those cases of acute cystitis in which instillation of a soothing medication is desired. It consists of a container, A, from which the fluid flows through an adjustable clamp, B, and

a dropper, C, to a large reservoir, D, from which an air vent, E, and a siphon arm, F, arise. When the fluid in E rises above the
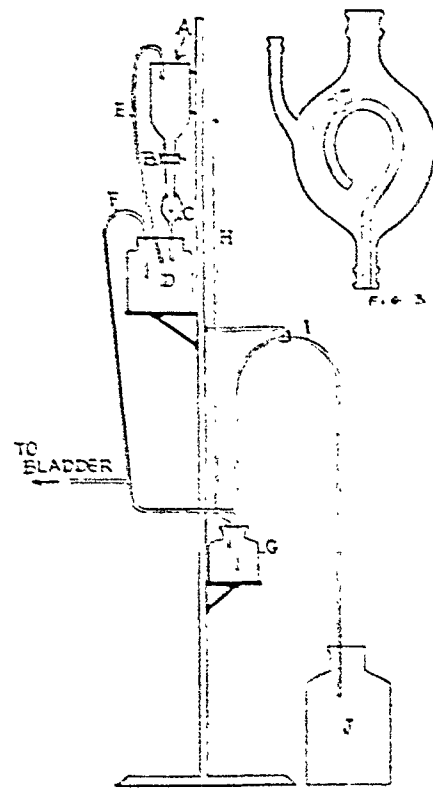
Figs. 2 and 3. Schematic drawing of apparatus to instill measured quantity fluid into bladder.

arm, F, the siphon will work and the entire contents of the reservoir, D, will be discharged into the system. The fluid will first fill the small reservoir, G, then rise in the air vent, H, and siphon arm, I, and then be forced into the bladder. The siphon arm, I, must be adjusted to such a height that as soon as the reservoir, D, is empty, fluid will begin to pass over the siphon arm, I. The reservoir, G, and the bladder are emptied and the lower siphon broken as in the first apparatus. The upper siphon is broken by the air vent, E. The difference in size between the two reservoirs, D and G, will determine the amount injected into the bladder, as there will be approximately enough urine secreted between fillings to take care of the volume of the tubing.

Figure 3 shows how an expert glass blower can modify the upper reservoir to make the apparatus more compact and to reduce the number of corks which might leak air.

Munro stresses the use of small rectal tubes as catheters when using this type of apparatus. We have found that whistle tip catheters work just as well and, in addition, are made of better rubber and are easier to insert.

CONCLUSIONS

1. Two modifications of the tidal drainage apparatus for the urinary bladder are presented; one with a general application, the other with a very limited application.

2. Tidal drainage has been found by the urologist to be a valuable adjunct to the treatment of many urologic disorders.

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MUNRO, DONALD and HAHN, JOSEPH. Tidal drainage of the urinary bladder. New England J. M., 212: 229–239, 1935.

Correction: In the article, "Fifty Years of Anesthesia," which appeared in our January issue, it was stated on page 242 that Paul M. Wood was the editor of *Anesthesiology.* This is an error. Dr. Henry S. Ruth is the editor of that journal.

OXYURIS VERMICULARIS APPENDICITIS

THE INCIDENCE OF OXYURIS VERMICULARIS IN A SERIES OF 1,016 CASES OF APPENDICITIS

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IN a series of 1,016 operative cases of appendicitis at the Memorial Hospital of Greene County, (441 of which were the authors') from August, 1933, to May, 1940, there were eight cases of oxyuris vermicularis infestation of the appendix.

There are many synonyms for oxyuris vermicularis, namely: ascaris vermicularis, enterobius vermicularis, seat worm, threadworm, pin-worm, also called awl-tail, maw-worm and maggot. It is a small whitish round worm which in man infests the large intestine and very often the appendix. It is reported that they have been found as high as the cecum and have even been seen in the stomach and mouth. They apparently are incapable of multiplying in situ; for development, the ova must be swallowed. Many believe that the oxyuris plays no etiological rôle and that its occurrence in the acutely inflammed appendix is merely accidental. Invasion of the oxyuris into the mucosa of the appendix has been shown to be responsible for a considerable number of cases of appendicitis (seventeen in a series of 129, by Cecil and Bulkley).[2,4] This is an unusually high figure for as shown in our series we found only eight cases in the 1,016 studied. All removed appendices in this series were histopathologically examined. The oxyuris is, however, also found in apparently normal appendices, in the submucosa as well as in the lumen. Often little or no inflammatory reaction is found about the oxyuris; but while it may be impossible to demonstrate the point at which the organisms penetrate the mucosa, they are supposed to produce characteristically shallow hemorrhagic ulcers in the mucosa. (Figs. 1 and 2.) These might be the starting point of an acute inflammatory process not unlike that described by Aschoff.[5] Dean Lewis[6] states that "Oxyuris must be mentioned in a consideration of the etiology of appendicitis in children. They are occasionally encountered in the adult." This is apparent in our series although 40 per cent of our cases were adults. It would seem that the younger the individual, the more severe the clinical as well as the micropathological findings are when the appendix is infested with oxyuris. Parasites are not nearly so common in the suppurative and gangrenous forms of appendicitis as in the nonsuppurative type. In only one case was the appendix infested with oxyuris classified as a subacute appendicitis by the pathologist. All others were classified as "chronic." (Table 1.)

All the cases in the series of 1,016 studied were operated upon primarily for appendicitis, except for two cases. One was a prophylactic appendectomy (Case #4409) performed during the course of a hysterectomy; oxyuris vermicularis was found in the appendix on histopathological examination. In the second case (#3612), this patient was operated upon for a right ruptured ectopic pregnancy by the authors on September 3, 1939. Because of her precarious condition at that time it was deemed advisable not to remove the appendix, since there was no evidence of any gross pathological findings in the appendix. She made an uneventful recovery. Six months later, on February 27, 1940, she developed typical symptoms of appendicitis. The histopathological report on the removed appendix showed infestation with enterobius vermicularis. There was no previous history of pin-worms. As already mentioned, during the previous operation

of the right salpingo-oophorectomy for the ruptured tubal pregnancy, there was no evidence of worm infestation in the appendix when examined during the course of this operation. It, therefore, may be concluded from this, that if worms were present at an earlier date, they had not previously created symptoms or signs of

micularis infestation subsequently caused objective as well as subjective findings of appendicitis.

FIG. 1. Section of appendix Case No. 4598. Showing characteristically shallow hemorrhagic ulcers in mucosa. Cross section of oxyuris vermicularis in lumen of appendix. × 103.
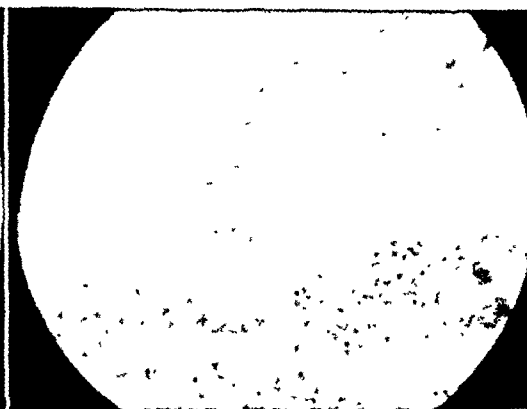
FIG. 2. Section of appendix Case No. 4598. Showing cross section of oxyuris vermicularis in lumen under higher magnification. Note cellular infiltration in this area and inflammatory reaction with disruption of mucosal continuity. × 480.

From the cases listed the incidence is greater in children and evidently excites more violent reactions in children than in

TABLE I

Case No., Initial Date of Operation	Age, Sex	Highest Preoperative Temperature	Total White Count	Per Cent of Polymorphonuclears	Per Cent of Eosinophiles	Histopathological Diagnosis, Bender Laboratory, Dr. John J. Clemmer
1. B. A. #4598... 6/11/40	5 yrs. Female	105°	21,400	86	0	Subacute appendicitis infestation with enterobius vermicularis
2. A. N. #3986. 11/29/39	10 yrs. Female	101°	15,200	50	1	Chronic appendicitis infested with enterobius vermicularis
3. W. F. #2875. 3/29/39	11 yrs. Male	99 5°	16,400	34	0	Chronic appendicitis oxyuris vermicularis in appendix
4. A. S. #3657 9/3/39	11 yrs. Male	101 1°	16,000	82	1	Chronic appendicitis with enterobius vermicularis
5. S. W. #1162. 12/7/37	6 yrs. Female	100.8°	17,800	76	2	Chronic appendicitis oxyuris vermicularis in appendix
6. M. B. #1191 10/26/34	23 yrs. Female	99 2°	16,800	80	0	Chronic appendicitis oxyuris vermicularis present in the lumen
7. H. F. #4409.. 4/24/40	34 yrs. Female	99 1°				Chronic appendicitis infestation of appendix with enterobius vermicularis
8. A. A. #3612... 2/29/40	26 yrs. Female	99 1°	8,700	49	0	Chronic appendicitis infestation with enterobius vermicularis

appendicitis; but there is definite evidence to show that appendicitis did occur and worms were found in the removed appendix, indicating that the oxyuris vermicularis lodged in the appendix of children (and less frequently in adults) produces a typical clinical picture of appendicitis. There is pain, vomiting,

adults. (Table I.) Oxyuris lodged in the appendix of children (and less frequently in adults) produces a typical clinical picture of appendicitis. There is pain, vomiting,

elevation of temperature, local tenderness, increased rigidity and leukocytosis. Eosinophilia is *not* a constant finding as shown by our records, and if present, is *not* very marked. The writers know of no method by which it can be differentiated unless one cares to rely entirely on the increase of the eosinophiles in the differential blood count. The most conservative plan to follow is to advise operation when typical signs present themselves, rather than depend entirely upon the eosinophilia alone, even when oxyuris vermicularis infestation is remotely suspected.

A. Battaglia and H. de Fiore[1] found that appendicitis is caused by oxyuris with a frequence of 2 per cent. Our figures in the series of 1016 cases reviewed show .007 per cent. Battaglio's and de Fiore's findings agree in that it is more frequent in children than in adults. They state that two patients out of the six of their group of eleven suffering from oxyuris appendicitis complained of symptoms of oxyuriasis— occasional dizziness with unconsciousness. In a review of our series there was no history of dizziness or unconsciousness.

The microscopic study of the removed appendix was performed in only three of the six cases in the series reported by Battaglia and de Fiore.[1] In our total of the eight cases charted, all the 1,016 appendices were microscopically examined. (Table 1.) The appendix was the site of chronic inflammation and typical oxyuris lesions. The hemogram in the three cases quoted by Battaglia and de Fiore showed an eosinophilia of 4, 5 and 8 per cent, respectively. As shown in our table, our eosinophilia findings were much lower; the highest in case #1162 was only 2 per cent. There was no mortality in the cases of oxyuris appendicitis. In only one case was there a history of inflammatory reaction with itching of the anal region prior to operation (Case #1191). The other cases gave no history of previous local anal irritation or infestation with pin-worms which is so generally accepted as characteristic.

CONCLUSIONS

1. In a series of 1,016 cases operated upon for appendicitis the incidence of oxyuris vermicularis infestation of the appendix was .007 per cent. This is considerably lower than figures quoted in previous literature.

2. Eosinophilia as a diagnostic differential point cannot be relied upon definitely.

3. Oxyuris vermicularis may be present in the appendix without creating symptoms of signs of appendicitis.

4. In the cases reviewed the exciting cause of the inflammatory reaction in the appendix was the oxyuris vermicularis, except in two cases, in which the worms were present without creating visible pathological findings.

5. In spite of eosinophilia being present, when objective and subjective signs of appendicitis are present, operation should be advised.

6. Infestation of the appendix with oxyuris in children usually creates more violent clinical as well as pathological reactions.

7. The oxyuris is rarely if ever found in suppurative and gangrenous forms of appendicitis.

8. Local symptoms such as itching and inflammatory reaction of the anus is not necessarily present and was reported in the preoperative history of only one case in the series studied.

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PLACENTA ACCRETA*

REPORT OF THREE CASES

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PLACENTA accreta is the abnormal adherence of the afterbirth to the underlying uterine wall. It is due to a

add the reports of three cases from the Bronx Hospital embracing a period from July 1, 1932, through March 1, 1938. Dur-

FIG. 1. Photomicrograph showing chorionic villi fused with myometrium. × 20.

FIG. 2. Photomicrograph showing an attachment of the hyalinized trophoblastic layer directly to the myometrium. × 20.

complete or partial absence of the decidua basalis, especially of its deep or spongy layer which results from the compression of the mucosal glands. The normal separation of the placenta is caused by the cleavage of this spongy layer. Absence of the decidua basalis forces the chorionic villi to attach themselves directly to the myometrium giving rise to the condition known as placenta accreta.

Irving and Hertig,[1] in 1937, reviewed eighty-six cases by sixty-eight authors, a complete summary of the literature, and added an additional twenty cases of their own. The incidence in their clinic was one case in every 1,956 deliveries. We wish to

ing this time there were 10,000 deliveries. Placenta accreta, therefore, occurred one in every 3,333 deliveries.

CASE REPORTS

CASE 1. H. J., No. 70574, age 24, gravida III, para 1. Her first pregnancy in 1933 resulted in a spontaneous abortion for which a curettage had been performed. The second confinement was complicated by a manual removal of a partially adherent placenta followed by a uterine infection. She had been hospitalized for fourteen days. The present delivery on October 15, 1936, was spontaneous after 4 hours of labor, although the membranes had ruptured five days before onset of pains. The

placenta failed to separate and as there was no bleeding the patient was put to bed. Bleeding began twelve hours later and manual extraction of placenta was attempted under anesthesia by Dr. A. J. Fleischer. It was impossible to determine a cleavage line, so the uterus was packed with iodoform gauze, a 500 cc. citrate transfusion given, followed by a supravaginal hysterectomy, bilateral salpingectomy and left oöphorectomy. Convalescence was afebrile and the patient was discharged on the seventeenth day.

The specimen consisted of a postpartum uterus with an entire placenta firmly adherent to the uterine wall. Attached to the uterus were both tubes and one ovary, the seat of an 0.5 cm. corpus luteum. Microscopically (Fig. 1) the specimen showed chorionic villi fused with the myometrium. Diagnosis: Placenta accreta.

Case ii. J. R., No. 72691, age 37, gravida ii, para i. The patient's first pregnancy in 1934 was complicated by a toxemia (pre-eclampsia). She had at that time a spontaneous delivery at seven and one-half months of a three pound baby which lived seventeen days. She was admitted as a private patient of Dr. A. J. Fleischer on December 17, 1936, because of a gravidity of two months and a recurrence of the toxemia. Eye and medical consultation advised interruption of pregnancy because of the presence of nephropathy. On December 28, 1936, a hysterotomy and sterilization under spinal anesthesia was done.

The specimen was a 6 by 5 cm. piece of yellowish-white tissue, apparently a portion of the uterus with an attached adherent placenta. Microscopically (Fig. 2) there was an attachment of the hyalinized trophoblastic layer directly to the myometrium. Diagnosis: Placenta accreta.

Case iii. S. G., No. 103993, age 27, gravida i, para o. In 1932, she had what was reported as a subtotal hysterectomy for fibroids with a reconstruction of the stump of the cervix and a part of the isthmus of the uterus. She was admitted to Bronx Hospital, service of Dr. Irving Smiley, from a private sanatorium where on September 10, 1939, she had a premature breech labor of seven months' gestation necessitating extraction. In the extraction the fetal head was left in the uterus. Her membranes had been ruptured since September 7, 1939, and she now had daily chills and fever. She was put under supportive therapy, sulfanilamide and transfusions, and on September

21, 1939, the ninth day after admission, she had a supravaginal hysterectomy and bilateral oöphorectomy performed. The uterus was

Fig. 3. Photomicrograph showing direct attachment of villi and hyalinized trophoblastic layer directly to the myometrium. X 20.

found to be the seat of a rupture across the top, and a large amount of placental tissue was attached to the interior of the uterus. The patient expired four days later from sepsis and peritonitis.

The specimen was a uterus 16 by 7 cm. in size, removed supracervically. There was a large perforation at the fundus. The upper half of the uterine cavity contained adherent placental tissue. Microscopically (Fig. 3) one could see the direct attachment of villi and hyalinized trophoblastic layer directly to the myometrium. Diagnosis: Placenta accreta.

SUMMARY AND CONCLUSIONS

1. Three cases of placenta accreta are reported. One was a true clinical case. The other two were discovered in the routine examination of surgical material.

2. The incidence in our clinic was one in every 3,333 deliveries.

3. The essential pathological condition is partial or complete absence of the decidua basalis so that the placenta is attached directly to the myometrium.

I am indebted to Dr. Meyer Rosensohn for his encouragement and advice, and to Dr. Joseph Felsen for his stimulating interest in the preparation of this report.

REFERENCE

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Case Reports

SUBTOTAL PNEUMONECTOMY FOLLOWING GUNSHOT WOUND*

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PNEUMONECTOMY today is regarded as the treatment of choice in primary malignant bronchial tumors and extensive chronic suppurating lesions such as total unilateral bronchiectasis and multiple chronic abscesses of the lung. The first pneumonectomy in the human was performed by Kümmell in 1910 for a pulmonary malignancy. The patient lived for six days and died of postoperative pneumonia in the contralateral lung. It was not until 1933 that Graham and Singer reported the first successful pneumonectomy for cancer of the lung. Nissen reported the first successful pneumonectomy for bronchiectasis in 1931, although Lilienthal performed the first operation for this condition (unsuccessfully) in 1919. In April, 1939, Dolley and Jones reported the first pneumonectomy for extensive unilateral pulmonary tuberculosis. During this short period, not only have the indications for the operation increased, but the technique and the results have improved to a point that offers the best and permanent relief of symptoms. According to reports in the literature up to July, 1939 the operation has now been performed 241 times: 147 for malignancy; ninety-two for chronic suppuration; and two for tuberculosis.

It is the purpose of this paper not only to report another successful pneumonectomy, but also to demonstrate that the indications for the operation are further widened to include serious traumatic pulmonary injuries with uncontrollable hemorrhage. In the case cited below, a penetrating gunshot wound of the lung at the hilum, pneumonectomy was never anticipated and was necessitated by uncontrollable hemorrhage.

In resecting a lung two methods of disposal of the hilum are commonly employed, namely: mass ligation and individual dissection; and ligation of the hilar structures. The latter method is the operation of choice in treating malignant lesions of the bronchus because it removes the entire organ and regional lymph glands and enables the surgeon to excise the bronchus at a point farthest beyond the growth. The former method is now usually reserved only in cases of the chronic inflammatory group. In excising the lung after mass ligation of the hilum a varying amount of lung tissue is retained in the stump and is utilized for burying the opened ends of the bronchi. This operation, strictly speaking, should be termed a "subtotal pneumonectomy" and the term "total pneumonectomy" should be reserved for the operation of individual dissection and ligation of the hilar structures. These terms are analogous to total and subtotal hysterectomy. The operation employed in the case reported was mass ligation of the hilum with resection of the major portion of the lung.

* From Surgical Service, Newark City Hospital.

The successful outcome of this case stimulated an interest in a study of traumatic penetrating injuries of the lung.

of the chest and in each case death resulted from a laceration of the lung with total hemothorax and marked mediastinal
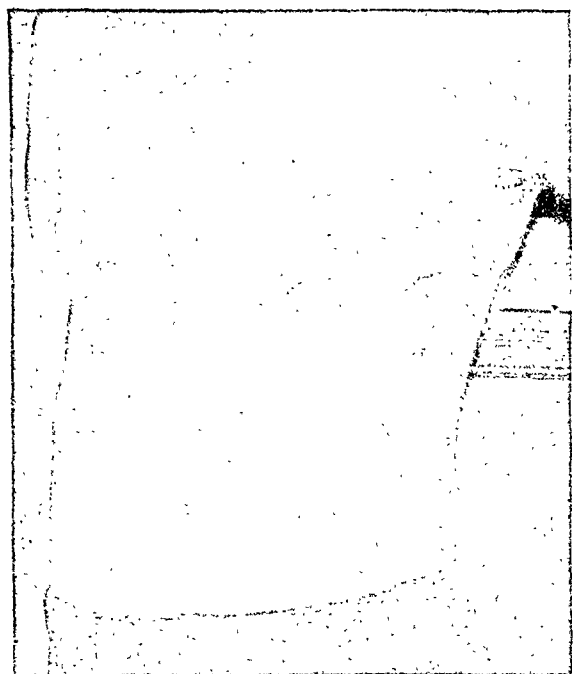
FIG. 1. Circle under left nipple marks wound of entrance of bullet.
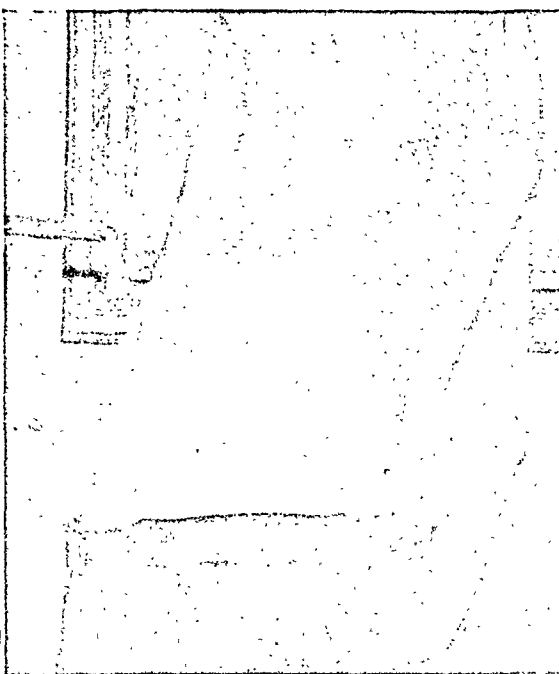
FIG. 2. Circle above incision marks wound of exit.

For this purpose, the files of the Essex County Medical Examiner, Dr. Harrison Martland, were studied. All cases of fatal gunshot and stab wounds of the chest from 1930 to 1939 were analyzed. A study of Table I shows that of fifty-one individuals with fatal gunshot wounds of the chest, forty-six had injuries not only to the lung, but also to neighboring vital structures which precluded any form of treatment. Of the five remaining victims, in whom only the lung was injured and a hemothorax was present, three died before they reached the hospital. Interestingly, in two of these three individuals the lung was injured near the hilum and both died in thirty minutes. Neither blood loss nor mediastinal displacement appeared to be responsible for the fatal outcome and postmortem examination disclosed the cause of death to be asphyxia, the result of blood flooding the uninjured lung. The remaining two patients survived five and seven hours respectively and might have received prompt surgical treatment.

There were seven fatal stab wounds

displacement. Four of the victims were dead before any medical aid could be given, but three lived from twelve to twenty-four hours and died of injuries that were easily amenable to surgery. Therefore in fifty-eight cases of fatal penetrating wounds of the lung prompt surgical intervention could have been applied in five instances.

TABLE I
WOUNDS OF CHEST 1930–1939
(Essex County Medical Examiner's Office)

Gunshot wounds of chest causing death	51
Wound through lung plus other vital structures	46
Wound of lung only	5
Dead on arrival (all with hemothorax)	3
Lived 5 to 7 hours (with hemothorax)	2
Stab wounds of lung causing death	7
Dead on arrival (with hemothorax only)	4
Lived 12 to 24 hours (hemothorax only)	3
Total cases for possible surgical intervention	5

As a result of this analysis it was thought expedient to study the cases of penetrating wounds of the chest that were treated at the Newark City Hospital during the same period (1930-1939). Only those cases that resulted in a hemothorax were selected

and the fatal cases of this group are included in Table I. In six gunshot wounds with hemothorax four were treated symp-

Fig. 3. Tension hemothorax with cardiac displacement.

tomatically and two required thoracotomy for drainage of subsequent infection. Twenty-three cases of penetrating stab wounds of the chest were treated conservatively without operation. Table II shows the cases treated at the Newark City Hospital.

TABLE II

SERIOUS WOUNDS OF CHEST

(Newark City Hospital 1930–1939)

Penetrating gunshot wounds of chest producing hemothorax	6
Cases treated symptomatically	4
Cases requiring subsequent thoracotomy	2
Penetrating stab wounds of chest producing hemothorax	23
Cases discharged within two weeks	15
Cases discharged after two weeks	8
Cases requiring operations	0

From the study of these two groups of cases it appears that penetrating wounds of the chest fall into two categories: first, those in which the symptoms of shock are slight or seem to be abating, and hemorrhage is controlled. These cases are treated conservatively although a hemo- or pneumothorax may be present. If mediastinal displacement produces cardiac embarrassment the increased pressure in the pleural

cavity must be relieved by aspiration. To prevent renewed bleeding from the reëxpanding lung after aspiration a pneumo-

Fig. 4. Postoperative film, September 12, 1939; left pleural cavity completely packed with gauze.

thorax should be induced. The second group consists of the cases in which the predominant signs are those of shock and mediastinal shift because of continued hemorrhage. In this type of case, an immediate exploratory thoracotomy should be done. Simple suture of the laceration and ligation of the bleeding vessel with reinflation of the lung will be sufficient to control the majority of this type of penetrating wounds of the lung. However, although to date no case has been reported it is conceivable that a lobectomy or pneumonectomy may be necessary because the simpler procedure is insufficient or because of extensive damage to lung substance. Once an exploratory thoracotomy is decided upon, one should have in readiness a Robert-Nelson or similar type of hilar tourniquet and be prepared to resect a lobe or even the entire lung.

In no previous war has resection of the lung for gunshot wounds been reported. Due to the advances made in thoracic surgery in the past few years we may expect many casualties in the present war where resection of the lung will be feasible.

CASE REPORT

W. von D., white male, age 27, was admitted to the Newark City Hospital about midnight, pleural cavity had been renewed. Aspiration of the left pleural cavity yielded 500 cc. of dark blood and his condition improved, but the next

FIG. 5. Film taken September 24, 1939, shows stump of left lung and tubal drainage of empyema. Eighth rib shows bullet wound; sixth rib posteriorly resected.
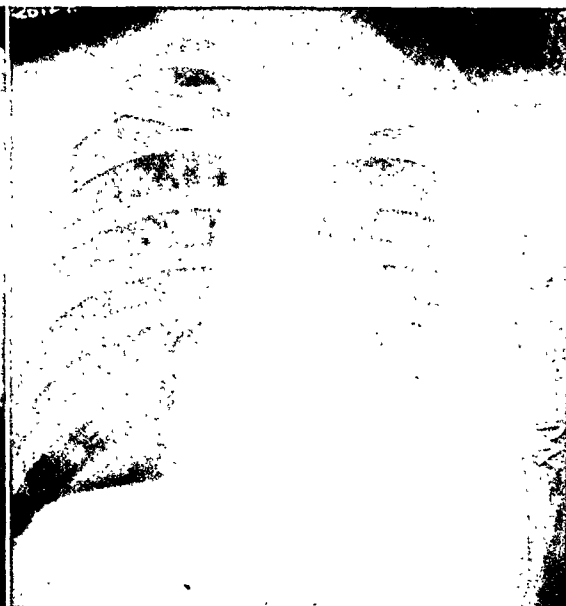
FIG. 6. Film taken October 13, 1939; begining expansion of remnant of left lung; lipiodol in left bronchus with small fistula.

August 17, 1939. He was semiconscious, perspiring profusely and in shock. His blood pressure was 100/60 mm. of Hg, his pulse of fair quality and respirations somewhat labored. He had had pneumonia at the age of 12, his father had died of pulmonary tuberculosis at the age of 48, and his first wife died of pulmonary tuberculosis at the age of 25.

Following a quarrel with his wife he became despondent and shot himself with a 38 caliber bullet through the left chest at what he thought was his heart. Examination of the chest showed the wound of entrance in the fifth intercostal space, just below the left nipple. The wound of exit was in the posterior chest, medial to the angle of the left scapula. Physical signs of fluid in the left chest were present. There was no hemoptysis or cough until the next day when he expectorated a large amount of bloody mucus.

After recovering from the initial state of shock and a severe serum reaction he appeared to be making normal progress, when suddenly on August 28, eleven days after admission, he became very dyspneic and cyanotic with a pulse of 136, respirations 48, blood pressure 90/50. Dullness was present over the entire left chest with marked displacement of the heart to the right. It was believed that bleeding in the left

day symptoms of anoxemia and respiratory embarrassment reappeared. Five hundred fifty cc. of bloody fluid was again aspirated from the left chest and a transfusion of 600 cc. of blood was given. The condition again improved, but the next day, August 31, signs of respiratory embarrassment were once more observed. This time, in spite of the removal of 650 cc. of dark bloody fluid and a 500 cc. blood transfusion, the patient's condition remained critical. He was very dyspneic and cyanotic with the pulse 130 and respirations 60.

At this point, the patient was seen by the author in consultation. It was suggested that further conservative treatment be continued but that chest aspirations should be followed by replacement with air to slightly positive pressure to prevent the collapsed lacerated lung from reëxpanding and renewing the hemorrhage. Twice, 500 cc. of bloody fluid was aspirated and replaced by air. Two 500 cc. transfusions and 3000 cc. of 5 per cent glucose in saline were administered that afternoon, but the signs of respiratory embarrassment and anoxemia became so marked that death appeared imminent. At this time, it was believed that the bleeding from a large hilar vessel was reactivated and remained uncontrolled in spite of marked collapse and displacement of the left

lung. An immediate exploratory thoracotomy offered the only chance to arrest the hemorrhage.

FIG. 7. Film taken December 4, 1939. Wound healed; further re-expansion of remnant of left lung; bronchial fistula freely communicating with residual pneumothorax space as shown by lipiodol.

The patient received oxygen in the sitting position and gas-oxygen anesthesia was started in this position because of the orthopnea. After a few inhalations, generalized convulsions set in, with extreme cyanosis, and the anesthesia was discontinued. The left chest was rapidly scrubbed with ether and painted with iodine. After paravertebal and local novocaine infiltration, the sixth rib was resected for about 7 inches posterolaterally and the left pleural cavity was opened. At this time, normal saline solution was administered through one of the veins of the foot.

On opening the chest, a large amount of bloody fluid and fibrin under marked pressure was released. Active severe bleeding was observed in the region of the left hilum anteriorly. The hilum was seized and compressed digitally and the mediastinum was drawn laterally. After this maneuver, the pulse could be felt feebly at the wrist. Blood was given through the intravenous apparatus. The lung was seen to be completely collapsed and the fibrin was removed from its posterior surface. The wound of exit in the left lower lobe posteriorly was clearly visible, but there was no active bleeding. When the blood clots were removed from the

anterior surface of the lung no wound was found. The digital pressure was released and profuse bleeding again appeared at the anterior hilar area. Digital pressure was renewed and a Roberts-Nelson tourniquet was applied around the left lower lobe because that lobe was severely damaged. When digital pressure was again released, hemorrhage reappeared. The tourniquet was removed and reapplied about the entire hilum and this procedure controlled the bleeding. Careful inspection failed to reveal the wound of entrance or the bleeding area of the lung. At this time, the temptation to leave the tourniquet in situ and retreat was very strong. However, it was thought that it would be better to remove the lung and close the chest rather than leave an open pneumothorax and let the lung slough out. A large stump of lung tissue was left at the hilum which was sutured with several chronic transfixion ligatures. Blood vessels were individually clamped and ligated. The entire pleural cavity was packed with five large pieces of gauze, after the method described by Jose Arce. The wound was closed except for the space allowed for the gauze to protrude. Treatment for shock was instituted. Specimens of resected portions of upper and lower lobes showed atelectasis with considerable hemorrhage in the lower lobe.

The next day, September 1, the patient's condition was good, his pulse 110, blood pressure 124/72, respirations 36, and temperature 101.5°F. Dressings were changed daily because of profuse bloody serous discharge. After two weeks, large pieces of gauze were removed daily for five days; the pleural cavity was then empty and rubber tube drainage was substituted. On September 24, the pleural cavity was irrigated with azochloramid solution because the drainage had become purulent and foul. There was no sign of a bronchial fistula. X-ray at this time showed the thickened parietal pleura, the prominent hilar stump, and beginning extension of the residual lung into the left pleural cavity. On October 13, a small amount of lipiodol was instilled into the left main bronchus. This demonstrated the absence of lipiodol in the remnant of the left lung and a small bronchial opening with pooling of lipiodal in the left pleural cavity. On two occasions, during irrigations which caused a severe cough, a piece of foul lung slough was ejected through the wound. Following this, the discharge became thin and odorless and the bronchus

became patent. X-ray, at this time, showed the disappearance of a portion of the sutured stump of lung at the hilum and the beginning of expansion of the remainder of the left lung.

The patient continued to improve and gained 21 pounds from the time he got out of bed to the day of his discharge from the hospital, November 12. He has been free of untoward symptoms and his wound is entirely healed. On December 4, x-ray following instillation of lipiodol showed the left main bronchus open, communicating directly with the residual pneumothorax space. The remnant of the left lung had further expanded and the left diaphragm was elevated. The left chest was diminished in size and was immobile on inspiration.

At the present time he is employed driving a taxi in Newark. He feels no discomfort at any time and does not become dyspneic in the course of his work. Examination shows the left chest contracted, smaller than the right, and immobile on respiration. Breath sounds are diminished. X-ray examination showed no further change than that seen in the x-ray in Figure 7.

CONCLUSION

For the first time, subtotal resection of the lung was done for a gunshot wound near the hilum.

Resection of the lung can be a life saving procedure in cases of uncontrollable hemorrhage following injuries of the lung.

The author is indebted to Dr. Harry B. Epstein for transferring the case; to Dr. Harrison Martland and Dr. Richard Dieffenbach for their assistance and suggestions; and to Miss A. Zartler, all of the Newark City Hospital. The photographs of patient and x-ray films were made and furnished by Dr. Harrison Martland.

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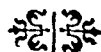
FEMORAL VEIN LIGATION FOR CHRONIC OCCLUSIVE ARTERIAL DISEASE*

A STUDY OF TWENTY CASES

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IN reading the voluminous literature which has appeared in recent years on the treatment of the chronic occlusive arterial diseases of the extremities, we cannot escape several blunt observations: (1) A wide variety of methods of treatment have been offered, and the surprisingly good results with one method of treatment frequently duplicate the good results reported with other treatments. (2) The results may be as good as reported because of individual methods and, on the other hand, the surprising correlation of good results may be due to the fact that only a certain percentage of patients can be benefited under any circumstances. (3) There may be undue enthusiasm on the part of an investigator reporting good results because of pride in his particular method or failure to exercise cautious judgment. (4) Some investigators have been unable to confirm the good results of a specific method of treatment, as reported by others. (5) Improvement may be due not at all, or only remotely, to a specific method of treatment, but rather to measures of good, general care such as cessation of smoking, rest in bed, warmth, and generally improved hygiene occurring as a result of regulated observation.

Furthermore, it is important to emphasize that practically all good results reported with the various methods of treatment are based essentially on clinical observations, with little, if any, objective evidence to support the conclusion that these treatments cause a definite increase in the flow of blood to extremities deprived of blood.

It was, therefore, with considerable temerity and mental reservation that the authors of this paper began a study of the value of femoral vein ligation in the treatment of occlusive arterial disease of the extremities. This surgical procedure received fairly frequent notice, for the most part favorable, in the literature up until 1934. We are convinced as a result of our experiences that femoral vein ligation has a valuable, though limited, place in the armamentarium of therapy of the occlusive arterial diseases and is deserving of renewed interest.

SUMMARY OF REVIEW OF THE LITERATURE

In a review of the literature we find the following:

1. Considerable opinion based on clinical results is offered to support the view that femoral vein ligation is at least of some therapeutic benefit in the chronic occlusive arterial diseases of the extremities.

2. There is more uniform agreement of opinion that the procedure is probably of greater clinical value in those cases in which acute or abrupt occlusion of the artery has taken place.

3. There is definite objective experimental evidence in animals to show that femoral vein ligation has produced a richer collateral arterial tree with a markedly lowered incidence of gangrene of the extremities, following abrupt mechanical occlusion of the femoral artery.

4. As yet no satisfactory objective or experimental evidence on animals has been submitted to support the clinical view that femoral vein ligation is of value in the chronic occlusive arterial diseases of the extremities.

5. The predominant theory offered to explain the therapeutic value of femoral vein ligation is that the increase in arterial and venous pressures of the extremity forces open a large number of previously inactive collateral vessels and makes available to deprived tissues an increased amount of blood nutriment.

CLINICAL STUDY OF TWENTY CASES

Our material comprises twenty cases of severe organic occlusive arterial disease of the lower extremities in which arteriosclerosis is the predominant feature. The age incidence varies from forty-two to ninety-two years; the youngest was forty-two; five cases were in the fifty to sixty year group, four in the sixty to seventy year group, seven in the seventy to eighty year group, two in the eighty to ninety year group, and one patient was ninety-two years old. A marked associated spasm is noted in two cases as evidenced by temperature release after nerve block. Diabetes mellitus is concomitant in six cases. One case, which will be discussed subsequently in detail, presents an acute arterial occlusion superimposed on a chronic endarteritis obliterans.

The cases selected for femoral vein ligations fall into two groups: The first group represents our primary indications for this procedure and consists of those cases in which gangrene was impending or was present in a minimal or early state. The second or palliative group includes those cases in which midthigh amputation was definitely indicated but in which amputation was refused by the patient or in which amputation was deemed unwise because of poor general status and a hazardous operative risk. A summary of the results with femoral vein ligation is tabulated under individual headings as follows:

Pain. In sixteen cases relief of pain within twelve hours was marked and often dramatic. In three cases there was only moderate relief, and one patient who was relieved immediately after operation developed a severe recurrence which required a neurectomy two weeks later. Some measure of lasting relief from pain was ascertained at a follow-up examination from three to twelve months postoperatively in nine cases. Of the remaining eleven patients, five required amputation from three to four weeks after femoral vein ligation, and six cases either could not be traced or are too recent to evaluate as to lasting relief from pain.

Pulse. In eighteen of our cases, palpable pulsation of the dorsalis pedis and posterior tibial arteries was absent. In two of these, the pulses became palpable following femoral vein ligation.

Course of Local Gangrene. In ten of the seventeen cases in which gangrene was present definite demarcation with spontaneous separation of localized gangrene was obtained following femoral vein ligation. There was a progressive spread of gangrene in five cases which necessitated midthigh amputation as previously mentioned. One case developed a postoperative psychosis and was transferred to another institution and the subsequent course could not be traced. Another patient developed a progressive gangrene but the poor general condition and extreme age made an amputation too hazardous a procedure and death resulted from toxemia.

CASE REPORTS

Case No. 98964, K. S., male, age 54 years. The patient was admitted with a history of frostbite and gradual onset of gangrene of the tip of left big toe. Pulses were absent. Skin temperatures before and after posterior tibial nerve block revealed no rise indicating organic occlusion of the arteries. Arteriograms corroborated these findings. Following a left femoral vein ligation, the skin temperature became elevated, pain disappeared and the gangrene demarcated early, allowing for easy removal of the slough. Follow-up eight months

later showed a maintenance of the improvement with absence of subjective symptoms.

Case No. 99494, H. T., male, age 53 years.

However, following a right femoral vein ligation, the peripheral pulses were found palpable and the ulcer healed. Follow-up examination

FIG. 1. Arteriogram with thorotrast taken immediately before femoral vein ligation.

FIG. 2. Arteriogram immediately before femoral vein ligation.

The patient was admitted in poor condition with a generalized arteriosclerosis, diabetes mellitus, right hemiplegia and impending gangrene of the right foot. The pulses were absent; skin temperatures showed a minimal increase following nerve block and the oscillometry readings were zero. Arteriography indicated organic occlusion. Following a right femoral vein ligation, the skin temperatures increased and the pain subsided. Follow-up eight months later showed complete absence of subjective symptoms and the skin felt warm to palpation.

Case No. 94493, C. D., male, 61 years of age. The patient was admitted with a gangrenous ulceration of the right big toe, generalized arteriosclerosis and diabetes mellitus. The foot pulses were absent, oscillometry zero and nerve block failed to elevate the skin temperature.

was not possible; the patient had moved to an unknown address.

Case No. 101352, G. C., female, 73 years old. The patient was admitted with an impending gangrene of the left foot, general arteriosclerosis and diabetes mellitus. Despite conservative therapy, the pulses were not palpable and oscillometry remained at zero. Gangrene followed. Arteriograms were taken before and one-half hour following a left femoral vein ligation. (Figs. 1, 2, 3 and 4.) Examination of the preoperative arteriogram showed a fairly good circulation evident down to about the ankle with a fair number of collaterals. No open vessels appeared below the ankle. On the postoperative plates, the anterior tibial definitely was open down to the dorsalis pedis region, an increased number of fine collateral vessels in the leg, and collaterals about the heel (not present in the preoperative plates). The arteriograms

revealed the opening up of collateral vessels as a result of the femoral vein ligation. One month later the patient was discharged with

Fig. 3. Arteriogram taken immediately after femoral vein ligation. Note increased collateral circulation.

the wound healed. Follow-up three months later showed maintenance of healing and absence of all subjective symptoms.

Case No. 99271, G. C., male, age 56 years. The admission diagnosis was general arteriosclerosis and impending gangrene of the right foot. Pain with claudication had persisted for the previous eighteen months. Petechial and embolic lesions were present in the skin of the right foot. Nerve block with skin temperatures and oscillometry indicated organic occlusion. Following a right femoral vein ligation, the skin temperature became elevated. Pain persisted but improved slowly. One month later, the patient was discharged. All subjective symptoms had cleared up. Follow-up seven months and one year later showed complete relief.

Case No. 91067, J. A., male, age 86 years. A senile male was admitted with the diagnosis

of generalized arteriosclerosis and impending gangrene of the right foot. The right great toe was ulcerated and gangrenous. Conservative

Fig. 4. Arteriogram taken immediately after femoral vein ligation. Note increased collateral circulation.

treatment was followed for one month but the gangrene progressed rapidly. The patient refused an amputation. At this time, impending gangrene of the left foot was evident. Pain was extreme. A left femoral vein ligation was performed and the femoral artery was found pulseless and completely occluded. Postoperative improvement was satisfactory and the patient was discharged without subjective symptoms two months later. Follow-up in six months showed that the patient had died of natural causes and that the foot had remained in good condition.

Case No. 97755, M. H., male 68 years old. The patient was admitted with a diagnosis of impending gangrene of the third toe of the right foot complicated by diabetes mellitus. Conservative treatment was to no avail. A femoral vein ligation was performed one month later. There was a postoperative improvement in the collateral circulation. However, a superadded infection necessitated a midthigh amputation. The patient was discharged three months later.

Case No. 98892, D. C., male, age 72 years. The diagnosis on admission was generalized arteriosclerosis and beginning gangrene of toes

of right foot. Femoral vein ligation gave marked relief from pain, increased skin temperature and a return of the foot pulses. On the third postoperative day, the patient became psychotic and was transferred to a psychiatric hospital. There has been no response to our follow-up letter.

Case No. 95943, S. M., female 42 years of age. This was a diabetic patient who had developed an ulceration on the right big toe two months prior to admission. In spite of conservative treatment, the gangrene persisted and an osteomyelitis of the toe ensued. A left femoral vein ligation was performed one month later, the necrotic bone removed and the soft tissues drained. The circulation improved and the necrotic tissue gradually disappeared. On discharge from the hospital two months later, the wound was clean, granulating and nearly healed. The patient was up and about and symptom-free. Follow-up was not possible; patient had moved to an unknown address.

Case No. 7843, A. G., female 70 years of age. The patient was admitted with generalized arteriosclerosis and infected gangrene of the right great and second toes. The gangrene spread to the third and fourth toes during conservative treatment. Femoral vein ligation was followed by improved collateral circulation, cessation of pain and eventual spontaneous demarcation and healing of the stumps within five months. Follow-up one year later showed healed stumps and on absence of subjective symptoms.

Case No. 4843, T. H., male, age 77 years. The diagnosis on admission was generalized arteriosclerosis and gangrene of the fourth toe of right foot. Femoral vein ligation resulted in spontaneous amputation of the toe on the ninth postoperative day. However, infection developed at this time and within two weeks a midthigh amputation was necessitated. It was important to note that contrary to all expectations, many large collateral bleeders were present, instead of the usual almost bloodless amputation in such cases of advanced occlusion with arteriosclerosis, as noted by Spurrell. Follow-up one year later showed a satisfactory healed stump.

Case No. 3902, J. S., male, age 56 years. The patient was admitted with a diagnosis of generalized arteriosclerosis and moist gangrene of the right great toe. Arteriograms showed block of the dorsalis pedis and posterior tibial arteries. The toe was disarticulated and three days later the femoral vein was ligated. Although there was immediate relief from pain and increased skin temperature, the gangrene spread. A midthigh amputation was performed. The stump healed well.

Case No. 90012, male, 76 years of age. The patient was admitted with a diagnosis of generalized arteriosclerosis, auricular fibrillation and moist gangrene of middle toe of right foot. Pain was very severe and the patient required constant morphinization. There was immediate relief of pain and increased local warmth following femoral vein ligation. The wound was completely healed within one month. Follow-up seven months later revealed a healed toe and complete absence of subjective symptoms.

Case No. 4288, D. G., age 92 years. The diagnosis on admission was generalized arteriosclerosis and gangrene of right small toe. There was no response to conservative treatment. A femoral vein ligation gave definite relief from pain. The gangrene remained dry and clean until one month later when secondary infection set in. The patient refused an amputation and died three weeks later.

Case No. 697, M. L., female, age 75 years. The diagnosis on admission was diabetes mellitus, generalized arteriosclerosis and gangrene of the left second toe. Following a femoral vein ligation, pain disappeared, the gangrene became dry and spontaneous amputation took place one month later. At this time, uremia developed and death occurred two weeks later.

Case No. 759, N. W., male, age 63 years. The patient was admitted with a diagnosis of diabetes mellitus, generalized arteriosclerosis and gangrene of the left big toe and foot. Pain was severe. The circulation appeared very poor. The left femoral vein was ligated and it was noticed that the accompanying artery was completely occluded. Two weeks later, lymphangitis appeared. The patient refused amputation but consented two weeks later. Death ensued on the second postoperative day.

Case No. 1024, J. M., male, 56 years of age. The diagnosis on admission was generalized arteriosclerosis, left hemiplegia, pulmonary tuberculosis and moist gangrene of right big toe. Oscillometry, arteriography and histamine flares revealed an almost complete organic occlusion. Following a femoral vein ligation, relief from pain was prompt but the skin tem-

perature remained fixed. Improvement was noted for about six months. At this time, an infection occurred which subsequently necessitated a midthigh amputation.

J. W.,* male, age 75 years. The diagnosis on admission was auricular fibrillation, hemiplegia and peripheral vascular disease. The patient apparently had an acute embolic upset of the left leg about two weeks ago with increasing coldness, gangrene and mummification of the left great toe. Examination revealed the absence of palpable peripheral pulses, a well demarcated gangrenous process and no evidence of sepsis. Because of the history of acute arterial closure over two weeks old, femoral vein ligation instead of amputation was performed. This was followed by prompt relief from pain, increased skin temperatures and the gangrenous area became dry and demarcating.

E. R.,* female, age 68 years. The patient was admitted with a diagnosis of generalized arteriosclerosis and infected moist gangrene of right big toe. Suppuration and necrosis progressed. The patient refused a midthigh amputation. Following a femoral vein ligation, the pain subsided, the foot felt warmer and the gangrenous process began to localize. At present, healing is definite.

A. C.,* male, 76 years of age. The diagnosis on admission was arteriosclerotic moist gangrene of left foot and ankle. There was constant severe pain and elevated temperature. The patient refused a midthigh amputation but agreed to ligation of the femoral vein. At the time of operation, the soft tissues were debrided and drained. Following the operation, pain was markedly relieved, the wound became clean and granulations appeared. The patient was transferred to a hospital for chronic disorders two months later with the gangrenous areas clean and granulating.

SUMMARY AND CONCLUSIONS

1. Twenty cases of occlusive arterial disease of the lower extremities in which femoral vein ligation was performed, have been presented and studied with follow-up for periods ranging up to two years.

2. Definite relief of pain has been affected by this procedure in the majority of cases studied.

3. Local demarcation and spontaneous separation of gangrenous tissue has been

* Case number is designated only at time of discharge from hospital.

facilitated by femoral vein ligation in at least ten out of seventeen cases of gangrene.

4. The opening up of new collateral vessels is believed to have been produced and was satisfactorily demonstrated in at least two cases.

5. Restoration of pulsation of the femoral artery was demonstrated in two cases after femoral vein ligation.

6. There was no harmful or untoward effects as a result of the venous stasis produced.

7. Femoral vein ligation is a simple procedure, easily performed under local anesthesia and unattended by any morbidity or mortality.

8. We believe this procedure to be of definite value in impending or early minimal gangrene of the lower extremities in the chronic occlusive arterial diseases.

An additional thirty cases of femoral ligation have been performed since this manuscript was submitted and corresponding good results were noted.

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FEW cases with general congestion of the venous system will fail to be detected, for they are always breathless on slight exertion, are often cyanosed, and all show clear signs in the veins of the neck when recumbent. From—"The Soldier's Heart and the Effort Syndrome"—by Thomas Lewis (Shaw and Sons Ltd.).

DIVERTICULUM OF FEMALE URINARY BLADDER
A MODIFIED OPERATIVE TECHNIC

CASE REPORT

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BLADDER diverticulum in the female is comparatively rare. This may be because many remain silent lacking defined neck. The first are generally considered true congenital anomalies, while the others may conceivably be due to pro-

FIG. 1. Bladder with large single diverticulum.

FIG. 2. Pyelouretero cystogram five months after operation.

the bladder neck obstructions which in the male call attention to their presence. Pugh considers 2½ per cent occur in the female; Young 10 per cent and Judd and Scholl consider diverticula of the female bladder extremely rare, reporting only two in a group of 123 cases.

Clinically there are two types, true and false. In the first, the wall is composed of mucosa, submucosa, and some or all of the bladder muscle layers. They are apt to be single and large, and to have a distinct, narrow neck. In the second type the wall is composed of mucosa and thinned out muscle, or connective tissue. This type is more often noticeable, usually with a larger opening into the bladder and a poorly

longed obstruction in an old or weakened bladder. It is this type which is commonly seen in elderly men suffering from prostatic obstruction.

The following case is an interesting example of the true type occurring in a female. There was no evidence of any obstruction at the bladder outlet. As will be seen from the microscopic report of the tissue removed, this diverticulum was composed of all the true bladder layers. It remained quiescent until the patient's forty-sixth year, dormant through four full term pregnancies and one laparotomy, awaiting that degree of infection necessary to cause the one attack of cystitis which led to its discovery.

A widow of 46 was admitted to the Bristol Hospital May 12, 1926, with complaints of frequency, dysuria and pain in the left lumbar

FIG. 3. Cystogram two years after operation.

region. For three weeks before admission, she had had a constant left, dull, lumbar backache. This pain had never occurred before; it did not radiate, was worse when she was tired, but was never unbearable. Since the onset of this pain she had had frequency of urination and pain at the end, quite severe and accompanied by tenesmus. Before admission to the hospital her

were normal and the blood pressure was 160/100. There was a moderate uniform enlargement of the thyroid, but the basal meta-

FIG. 4. Pyelogram two years after operation.

bolic rate was minus 4. There was no tenderness in either lumbar region. Pelvic examination
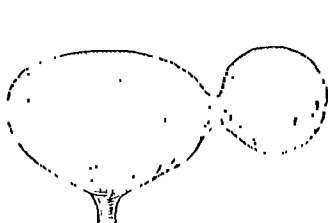
FIG. 5.   FIG. 6.   FIG. 7.

FIG. 5. Schematic bladder and diverticulum.
FIG. 6. Neck tied and doubly clamped; diverticulum excised; still distended purse-string suture set.
FIG. 7. Stump being inverted and purse-string suture tied.
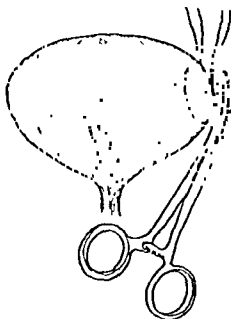
attending physician had given her a course of argyrol bladder instillations without any relief of symptoms. High-strung, rather neurotic, a sufferer from severe headaches, she had never been in robust health.

At the age of 36 she had had a suspension of uterus and an appendectomy. Four full term normal pregnancies and this operation were the only points of interest in her past history. Oddly enough, these had caused no symptoms referable to the bladder.

The temperature, pulse, and respirations

showed a firm perineum, no cystocele, a normal cervix, and a small uterus well up in anterior position. No masses were felt.

Cystoscopic examination revealed a marked general cystitis, making it impossible properly to fill the bladder or to locate the ureteral orifices. In the left lateral wall there was an opening about the size of a lead pencil which was recognized as the mouth of a diverticulum. Phenolsulfonephthalein excretion was 30 per cent in two hours. A catheterized specimen of urine was turbid and alkaline, showed a trace

of albumin, no sugar, and a large amount of pus.

The patient was given a course of bladder irrigations with rest in bed. On May 22 a second cystoscopy was performed and the ureters easily catheterized. The diverticulum opening appeared well above the left ureteral orifice on the posterolateral bladder wall. Specimens were obtained from both sides. The right was normal and the left showed a considerable amount of pus. Intravenous P.S.P. test showed a normal appearance time on both sides.

On May 24, under gas oxygen and ether anesthesia, a cystoscope was passed and a No. 6 catheter inserted in each ureter. The cystoscope was removed and the bladder was filled with boric solution through a large rubber catheter. The catheter was left in the urethera and clamped. The bladder was exposed and by slow finger dissection well mobilized on all sides. The left ureter passed along the inferior posterior border of the diverticulum. The diverticulum could be dissected free from the ureter; its small neck entered the bladder about 3 cm. above the entrance of the ureter. (Fig. 5.) The muscular coats and the thin tissue about the neck of the diverticulum were tied with No. 1 chromic catgut close to the bladder wall.

layers about the drain. A self-retaining catheter was left in place.

Sections of the specimen showed chronic
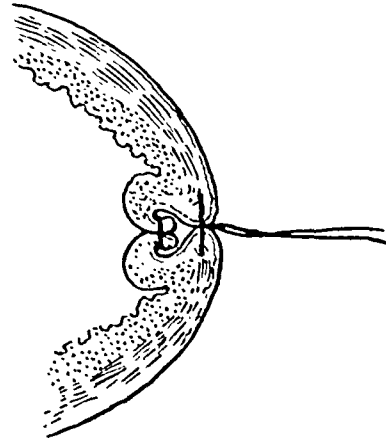
FIG. 8. Cross section showing stump inverted and purse-string suture tied.

infection of the bladder wall. The columnar epithelial lining was normal but beneath it there was a generalized infiltration of small round and plasma cells. Muscular and outer connective tissue layers were normal. All the normal bladder wall structures were found in this specimen; the diverticulum could therefore only have been a congenital anomaly.
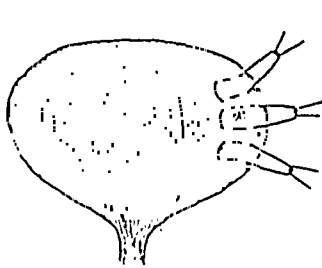
FIG. 9.   FIG. 10.   FIG. 11.

FIG. 9. Mattress sutures covering purse-string suture.
FIG. 10. Continuous sutures reinforcing mattress sutures.
FIG. 11. Final appearance of suture line.
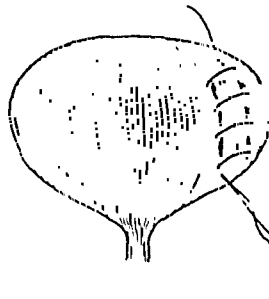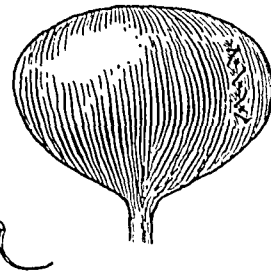
Two clamps were placed distal to this ligature, the neck cut between the clamps, and the diverticulum, still distended, removed. (Fig. 6.) The stump was cauterized with carbolic acid and alcohol. A purse-string suture of No. 1 chromic catgut was placed around the stump, most of the fluid in the bladder having been withdrawn. The stump was inverted well into the bladder, and the purse-string tied. (Figs. 7 and 8.) The site of the buried stump was covered with two rows of chromic sutures. (Figs. 9–11.) A rubber tube drain was inserted along the bladder and the wound was closed in

After a rather stormy first week during which there was considerable bloody serous drainage from the abdominal wound, the patient's pulse and temperature became normal, and the sutures and drains were removed. At no time was the wound drainage uriniferous. On the fifteenth postoperative day the self-retaining catheter was removed and the patient was allowed out of bed. Five days later she had a sharp left pyelitis lasting four days. She was discharged on the thirty-fourth postoperative day, free from symptoms and voiding normally.

Cystoscopy on November 11, showed no cystitis. The site of the diverticulum opening was marked by a well-healed stellate scar. A No. 7 catheter was passed easily into the left side. Both ureteral specimens were normal. The patient was entirely cured of her bladder symptoms and had remarkable relief from her headaches. Twelve years after operation the patient was well and had had no bladder symptoms since her operation.

SUMMARY

A case of diverticulum in the bladder in the female is reported. This diverticulum was found to be made up of all the true bladder layers and must therefore have been a congenital anomaly.

A modified technique for the removal of diverticulum is presented. The method used here and suggested by Young is applicable only to such diverticula as are of good size, with thick wall and a distinct narrow neck, where there is no other reason for opening the bladder. Under such conditions it is technically less difficult, traumatizes the bladder less and should give a shorter convalescence than the more frequently described extra- or intravesical methods of excision.

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MALIGNANT MELANOMA

REPORT OF A CASE RECURRING AFTER FOURTEEN YEARS

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MALIGNANT melanoma, with or without operation, is surpassed by no other tumor in its tendency toward rapid local growth or widespread dissemination. However, instances in which there are long delays before recurrences are not rare. Repeated cauterization of areas has been done over a period of several years[1] before generalized metastases occurred. Many years have passed after thorough excision only to be followed by local reappearance or extensive, rapidly progressive, generalized metastases.

William H. Wilder,[15] before 1900, emphasized the importance of giving a guarded prognosis, even after many years, as he had noted melanotic sarcoma in the liver thirty-two years after enucleation of the eye for melanosarcoma of the choroid. Albers reported local recurrence twenty-four years after excision of the primary tumor and Farrell[2] recorded an instance in which generalized metastases appeared eighteen years after removal of the original lesion. Lawbaugh[16] had a patient with involvement of the liver seventeen years after removal of melanosarcoma of the eye. Farrell had another case with local recurrence fifteen years after excision. Fisher and Box[3] found a large melanoma of the liver 14 years after enucleation of an eye for primary intra-ocular melanoma.

Lukens[4] and Newton[5] each had one case with local return of orbital tumor after thirteen years, whereas Wilbur and Harlman[1] observed delayed generalized metastases after thirteen years affecting the abdominal organs, skin and pleura, without demonstrable disease in the accepted primary focus, namely, the eye.

The present case is recounted to call attention to another instance with appearance of metastases after many years during which the patient's health was excellent, and to call attention to the blood picture and the existence of an unidentified urinary pigment.

The patient, a 64 year old white man, who had done clerical work for many years, first consulted one of us (W. N.) in September, 1924, because of a mole in the skin of the epigastrium. This had been present all his life, had not increased in size or given any trouble until four weeks previously when there was onset of itching and deepening of coloration. He had applied iodine, alcohol and ether without any effect. The accompanying photograph shows location of the tumor. The more central portion was quite dark in color, the edge lighter as indicated. The darker portion showed evidence of irritation and a tendency to bleed. The skin attachment was freely movable, no adjoining skin nodules were present and no regional glandular enlargement was observed. Under local anesthesia the mole was removed with a wide margin and a skin graft applied. Pathologic examination proved the tumor to be a malignant melanoma. (Figs. 1 and 2.)

Recovery was excellent and health splendid until June, 1938, when the patient seemed to lose vigor, became weak, tired easily and experienced diminished appetite. He received symptomatic treatment until consulting one of us (W. G. H.) on November 21, 1938. Six weeks before this there was onset of dull, constant, retroxiphoid discomfort and difficulty in swallowing solid food. For two weeks, only soft or liquid food could be taken and this was frequently vomited either before the meal was finished or within one-half hour after it. There had been slight constipation. No blood was present in vomitus or stools. A persistent cough productive of a small amount of thick, gray sputum had been annoying. Some deep soreness over the mid portions of both sides of the anterior chest had been present. Loss of strength had been progressive and weight had

decreased from 165 pounds in June, 1938, to 127 pounds on November 21, 1938.

Physical examination showed a thin, pale,

mann was negative. Gastric analysis showed no free hydrochloric acid after histamine and stools contained no blood. The icteric index was eight
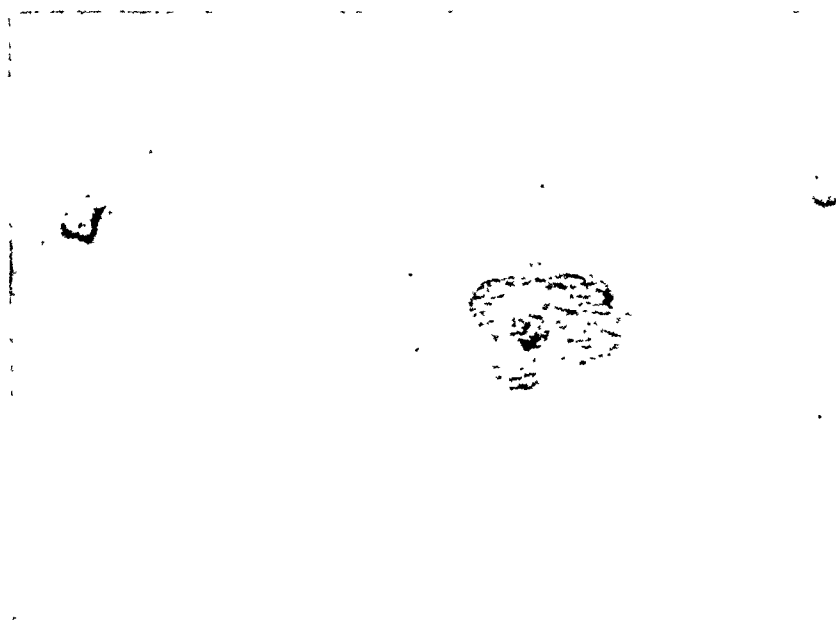
FIG. 1. Primary lesion on epigastrium showing evidence of trauma.

not acutely, but apparently seriously ill man. There was an 8 cm. curving scar high in the epigastrium, about which there were no nodules or discoloration. The lungs were clear and there was no glandular enlargement. In the left posterior axilla there was a soft, freely movable lobulated mass with a fairly sharp edge which the patient stated had been present for at least twenty years, and this appeared to be a lipoma. The sharp, non-tender edge of the liver was palpable 3 cm. below the costal margin in the right mid-clavicular line. It descended well on inspiration.

X-ray examinations of the chest, spine, pelvis, long bones, gall-bladder and gastrointestinal tract showed no abnormality. The urine was clear with respect to routine examination (including inspection for Bence-Jones protein), but the test for urobilin was strongly positive and there was present in nearly all specimens a deep red coloration. The hemoglobin was 86 per cent; red blood cells, 3,940,-000; white blood cells, 4,350; with segmented neutrophils, 38 per cent; staff forms, 25 per cent; myeloblasts, 1 per cent; premyelocytes, 1 per cent; myelocytes, 3 per cent; lymphocytes, 16 per cent; monocytes, 16 per cent. One nucleated red blood cell was noted. The Wasser-

and the Van den Bergh negative. Upon inspection two weeks later the liver had symmetrically enlarged so that the lower border reached the level of the umbilicus in the right mid-clavicular line and gave rise to abdominal fullness. Its surface was smooth. At this time three firm fixed nodules, averaging 1 cm. in diameter, were palpated in the left axilla. These were twice as large two weeks later when consent was obtained for removal of one for study. (Biopsy by Grant E. Ward.)

Study of the tissue removed showed the following characteristics: Specimen was approximately 3½ × 5 or 6 cm. and had a reddish-purple color. It was firm and the growth had not pierced the capsule of the gland. On cross-section the normal architecture of the lymph gland had been destroyed entirely. The cut surface was firm and grated in places, which were whitish in color, but for the most part it was dirty-gray with many small, black spots. The normal architecture of the node was entirely destroyed and all lymphoid tissue had been replaced by tumor cells. These cells were anaplastic, varying greatly in size and shape; the nuclei stained quite darkly and the cytoplasm was granular with indefinite cell outline. Mitotic figures were seen. There was consider-

able brown pigment scattered throughout the sections; many cells were loaded with this material. The diagnosis was *malignant melanoma,*

We are acquainted with two other instances in which a dull red coloration of the urine was noted. One of these patients had
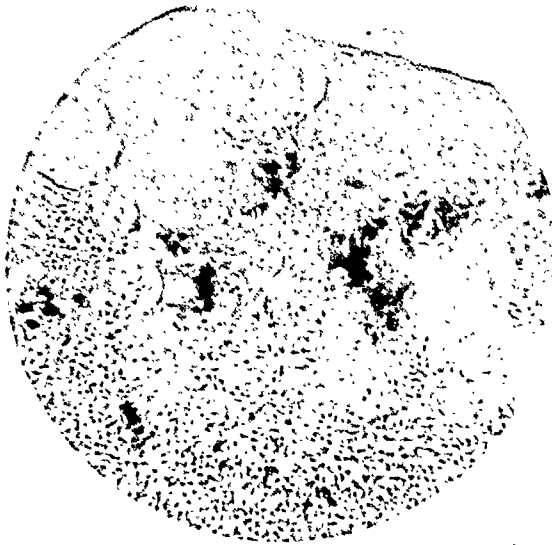
FIG. 2. Epithelium and subepithelial tissues contain melanin. There is increased vascularity in the derma. There is alveolar grouping of polyhedral cells that seem to have pushed their way downward beneath the basal epithelium. These cells show hyperchromatic nuclei and occasional mitotic figures. Diagnosis: Melanoma with malignant changes.
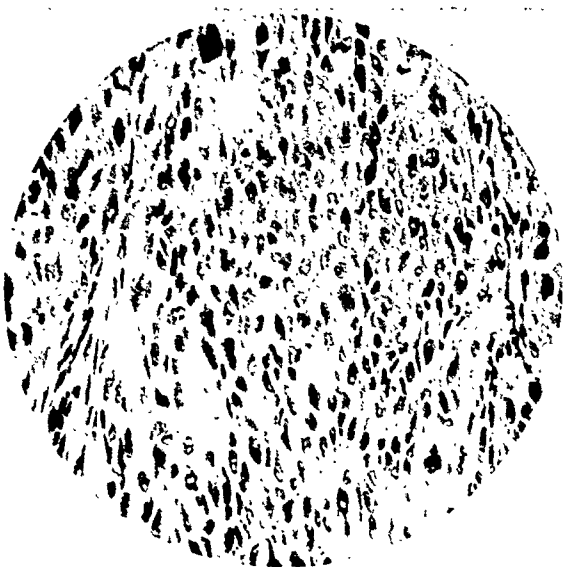
FIG. 3. Tissue is entirely composed of tumor cells. The cells are both the large polyhedral and small round cells of highly anaplastic type. They contain a small amount of melanin and are similar in appearance to those in the smaller areas in Figure 2. Mitotic figures are seen. Diagnosis: Metastatic melanoma.

metastatic. (Histologic report by Hugh R. Spencer, Professor of Pathology, Medical School, University of Maryland.)

The remainder of the patient's course was interesting only in that the liver continued to enlarge; multiple, firm, dull, bluish-purple nodules, up to 1.5 cm. in diameter, appeared generalized in the skin and the dull red urine changed to a thick brown. This latter color was believed caused by the presence of melanin pigment.

The course was progressively downhill and death occurred four months after the onset of symptoms of his final illness, fourteen years and three months after excision of a malignant melanoma from the epigastrium with intervening freedom from related signs and symptoms.

The finding of a large number of immature leucocytes caused some difficulty in diagnosis at first and suggested the possibility of an aleucemic leucemia. It is believed that the presence of these young forms, in this instance, indicates invasion of the bone marrow by the neoplasm.

a primary carcinoma of the liver, the other metastatic carcinoma to the same organ, the primary neoplasm being of the stomach. In both cases, the liver involvement was extensive. These facts caused some speculation as to the nature of the substance coloring the urine. The pigment was stable to light, but not to alkali, and gave a positive Van den Bergh reaction even in the absence of an elevated icteric index or a positive blood Van den Bergh.

In the absence of evidence of increased blood destruction, the presence of the strongly positive urobilin reaction of the urine points to liver dysfunction. This, coupled with the extensive involvement of the liver by tumor in our case and in the two cited, causes us to wonder whether we are dealing with some unidentified pigment related to bilirubin and giving the positive Van den Bergh reaction in the urine without an increased blood bilirubin.

In the absence of local recurrence many years after removal of a malignant mela-

noma, the appearance of extensive generalized malignant melanomatosis gives rise to speculation as to whether the generalized disease has arisen from another undiscovered primary lesion, or whether previous metastatic tumor cells have remained dormant, due to some unusual resistance of the host. It has been suggested that this delayed recurrence may be the result of temporary lowering of this resistance or an increase in the virulence of tumor cells, or possibly a combination of both.

It is worthy of note here that Wigby and Metz[6] observed regression of extensive subcutaneous and visceral metastases of malignant melanoma following vigorous Roentgen irradiation of the pituitary gland. They offer as a possible explanation the suggestion that one or more of the secretory substances of the pituitary "necessary for the growth or reproduction of the melanoblast" are diminished or completely removed by this treatment.

On this basis, it would not seem unreasonable to suggest that in the present instance there may have been metabolic alterations giving rise to an increased amount of this pituitary secretion in the circulation and hence reactivation of melanoblastoma cells.

SUMMARY

The metastases of malignant melanoma may occasionally remain dormant for many years and then become active and extensive. A case of this type has been presented here and reference made to numerous similar reports in the literature of the past fifty years. Interesting features of the case cited consist of changes in the blood picture constituting a "shift to the left" in the granulocytes and the discovery of an unidentified urinary pigment.

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A CASE OF RETRACTILE MESENTERITIS ASSOCIATED WITH EARLY CARCINOMA OF THE GALLBLADDER*

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A CLINICAL entity which has appeared sporadically in medical literature since 1853, but which has received only recent attention in this country, is retractile mesenteritis. Originally described by Virchow, this disease found its way into many of the earlier surgical textbooks. Virchow believed that a circumscribed peritonitis with cellulitis and sclerosing degeneration in the mesentery caused the retraction he noted, and stated that this retraction was necessary to produce volvulus of the pelvic colon. Since Virchow's first report, authors have reported one or more cases of retractile mesenteritis in the literature. Trauma or tuberculosis were considered the etiological agents, but many other theories existed. At first described as occurring chiefly in the mesenteries of the colon, it was recognized, among others, by Jura in 1927, as occurring also in the mesentery of the small intestine, and it was Jura who evidently performed the first experimental work on this disease. He injected bacteria from the intestinal flora into the mesentery of the ileum, producing a lymphangitis and subsequent retractile mesenteritis. Even Brehm, as quoted in Keen's system of surgery (1908), urges that mesenteric shrinking must be considered as a disease, sui generis, which needs treatment. The comparative rarity of this disease, however, allowed it to fade gradually from textbooks and from the literature, until recent experimental work brought it once more to the front as a true entity with a definitely explainable pathogenesis.

In a recent article, Reichert, Gerbode and Halford completely reviewed the past literature and in an exhaustive and careful manner experimently corroborated the findings of Milone and Picco, who in 1935 produced mesenteritis experimentally by ligation of the lymphatic trunks of the root of the mesentery in rabbits. Milone and Picco gave a complete description of the development of retractile mesenteritis following this procedure, dividing this development into three stages. These consisted of diffuse edema, fibroblastic hyperplasia and sclerosis of the newly formed connective tissue.

Ligation of the artery alone did not produce mesenteritis, and Reichert, Gerbode and Halford were unable to produce it by ligation of either vein or artery or both. In the latter's experimental work, it was found that irritation or trauma to leaves of the mesentery did produce mild degrees of the condition.

In the present case it is our theory that metastatic carcinoma from the gallbladder to nodes at the root of the mesentery produced the disease by massive blocking of the lymphatics of the mesentery of the small intestine.

CASE REPORT

Mrs. E. P., age 52, referred to my service at the Peninsula General Hospital by Dr. G. Metzler, was admitted March 23, 1939. She gave a vague past medical history of an operation in 1914 in which "water was found in the body." This operation was performed in a small obscure hospital which kept no records. She had had four normal children and had otherwise been in good health until four months previous to admission when her present complaints began.

* Read before the Philadelphia Academy of Surgery.

These complaints were at first very vague, consisting of aches and pains in her back and along her left side, chiefly in the upper portion

pelvis. The former showed the scar of a previous lower midline incision. There was marked tenderness in the left lower quadrant and in

FIG. 1. The lymphatics of the gallbladder, showing the nodules at the root of the mesentery at the right, metastasis to which may produce retractile mesenteritis. (From the laboratory of research surgery, University of Pennsylvania.)

of the abdomen. This was gradually followed by indigestion, belching, feeling of gas in the abdomen, with increasing constipation and increasing pain in the back along the spine but below the shoulder blades. Some six weeks before admission she went to a Philadelphia hospital for study and treatment, remaining there about three weeks. At the end of this time she was told that she had an arthritis of the spine and an upper abdominal tumor for which operation was advised. This she refused and returned home on her own responsibility.

One week before admission she began to have vomiting and nausea, which appeared suddenly and, while copious at first, soon improved to a certain extent. The vomitus was chiefly bile. The remainder of her history was negative.

On admission the patient appeared as a highly querulous, moderately obese, white female who was seriously ill. Her T.P.R. was 98.2°F. — 90 — 22; her blood pressure 160/90. There was no jaundice, but the patient was extremely pale. The physical examination was otherwise negative except for the abdomen and

the right upper quadrant. There was no rigidity. A vague suggestion of a deep mass could be palpated in the epigastrium. This seemed to be a fixed soft mass with vague outlines.

Vaginal examination revealed bilateral cystic ovaries, the right the size of a lemon, the left that of a large orange. The uterus was about three times its normal size and contained an intramural fibroid.

Since the x-ray report of an upper abdominal mass pushing the duodenum to the right was available, no further x-rays were made. A gastric analysis showed no free hydrochloric acid in any specimen and a total acid no higher than twenty at any time. There was no blood, and microscopic examination of the gastric contents was also negative. The Kline and Wassermann tests were negative. There was considerable kidney damage as shown by albumen, casts and occasional red cells in the urine and a phenolsulfonphthalein test of 20 per cent in the first and 20 per cent in the second hourly specimens. The blood count demonstrated no anemia; Hb. 85 per cent,

R.B.C. 4,100,000 and W.B.C. 10,200 with 83 per cent polymorphonuclear cells.

After four days' treatment by daily intra-

rubber tube in Morrison's pouch, using steel wire in the fascia.

Following operation the patient had an
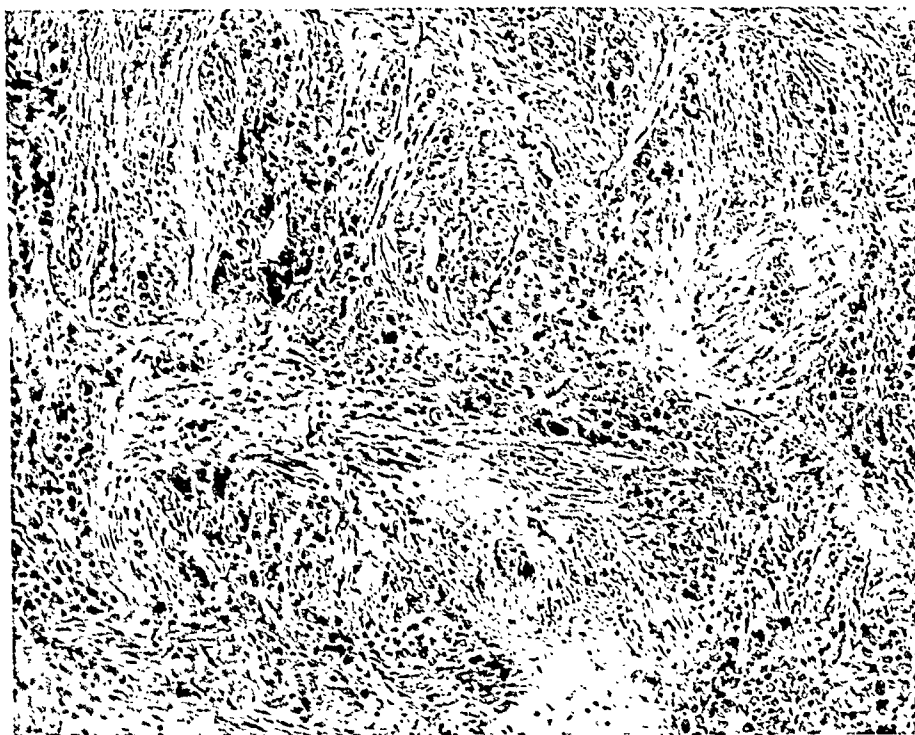
Fig. 2. Microphotograph of gallbladder carcinoma.

venous injections of saline and glucose, operation was performed on March 26. The abdomen was first thoroughly searched for the mass which had been diagnosed. This mass consisted of a swollen root of the mesentery and adhesions of the stomach to an enlarged and greatly thickened gallbladder. Nodules or enlarged lymphnodes could be palpated deep in the mass, but seemingly above the pancreas, which was normal. In the lower abdomen the omentum was found adherent to an area of sigmoid colon. The sigmoid colon was greatly shortened and its lumen was infringed upon by the omental adhesion and retraction of its mesentery. The colon was distended above this area. Release of the omental adhesion allowed the lumen to dilate and the distention of the descending colon promptly decreased. The gallbladder was very adherent to the liver and was freed with difficulty and removed. An attempt was made to secure a node at the mesenteric root, but due to edema and swelling of the mesentery and the great depth of these nodes against the vertebral column, the attempt was given up. The nodes were enlarged and were felt to be about the size of an almond shell. The wound was closed in layers with a

increase of pain in the back and a rather severe rise in T.P.R. out of proportion with the operation performed. The temperature rose to 103.4°F. on the second day with pulse rate of 140. This reaction rapidly disappeared and convalescence was normal except for the continued pain in the back and the persistence of a minor degree of fever until three days before discharge. Pathological examination of the removed gallbladder showed a carcinoma which seemed confined to its walls and was estimated as grade II malignancy.

The patient was discharged on April 13 with no complaint but the persistent backache, which had played a prominent part through all her illness. She remained well for only a week and was readmitted on April 22, with the history of severe vomiting and failure of bowels to move for two days despite all the customary measures. Her temperature on admission was 99.4°F., pulse 96, and respiration 22. Blood pressure was 136/70. The white blood count was now 12,650 with 72 per cent polymorphonuclears. The hemoglobin had shown a marked drop to 55 per cent and the red blood cells to 3,600,000. The blood chlorides were found too low to read, and the urine showed 1+ albu-

men, but was otherwise negative. The abdomen now showed a well healed scar without infection. There was considerable distention but no rigidity or generalized tenderness. There was a huge mass in the left and middle abdomen opposite the umbilicus. Many distended loops of bowel could be palpated about this mass.

A Miller-Abbot tube was passed. The tube would not go beyond the seven-foot level. Concentrated 5 per cent saline was given intravenously and both chloride and fluid balance restored to normal and kept within normal levels from then onward. Barium was placed in the Miller-Abbot tube but this merely demonstrated an obstruction without revealing its nature. The patient objected violently to the presence of the tube, removed it several times and even when restrained in some way removed it and refused to reswallow it. After a temporary improvement by use of the tube, the patient reached a standstill despite enemas, pituitrin, phisostigmin and other medications, the bowels failing to move or the mass to decrease in size.

An exploratory incision was made May 1 after ten days' treatment in the hope that a remediable lesion could be discovered. At this time the abdomen was still somewhat distended but much less than on admission. The mass was still present in the left and middle of the abdomen.

A left rectus incision was made in the center of the abdomen. No free fluid was present in the abdomen. There was no peritonitis. The previous incision and abdominal wall were free of adhesions. The omentum now covered a huge, rounded mass, which consisted of an edematous, swollen and retracted mesentery which had pulled all the bowel into a mass and surrounded the bowel in such a manner that only short loops of a few inches were visible and then only the antimesenteric surface, since the mesentery almost completely surrounded even these loops. Mesenteric surfaces were adherent to each other and bowel loops adhered to each other, so that the entire small intestine seemed to be drawn up short to the mesenteric root and engulfed completely by the mesentery to form a mass the size of a man's head. The colon, stomach and pelvic organs were entirely free of this mass. The gallbladder bed contained a few recent adhesions, but this area and the duodenum were also free of the process. The omentum was separated from the bowel with great care, and an area of kinked intestine identified as the obstructed one by finding the end of the Miller-Abbot tube in it. This kink was freed to release the obstruction and the tube passed a short distance beyond it until the loop vanished deep into the mass. Many other loops were retracted so much that it was obvious that obstruction was imminent in these loops. It was also obvious that any attempt to remedy the condition would have involved resection of the entire mesentery and the entire small intestine, a process too formidable even to consider. The wound was closed in layers without drainage.

Despite the hopeless appearance of the lesion seen at operation the patient seemed to do rather well for four days with the aid of continuous intravenous salt and glucose solution. The temperature did not rise above 100°F. and the pulse remained from 100 to 120. Vomiting was controlled by the continued use of the Miller-Abbot tube. On the fourth postoperative day the patient developed a fecal fistula through the recent wound and soon thereafter began to show signs of collapse with a gradually dropping blood pressure. She remained conscious and rational, but despite all measures died on May 8, eight days after operation. The bowels did not move but there were no physical signs of peritonitis. Permission for a postmortem examination was refused.

This patient illustrates a case of severe, massive retractile mesenteritis, ending fatally and probably caused by blockage of the mesenteric lymphatics by carcinoma originating in the gallbladder. Both operations, moreover, illustrated in the human two of the stages observed in animals, namely, the stage of fibroblastic hyperplasia and the later stage of retraction by hardening of the fibrous tissue and retraction of the entire mesentery. It seems to the writer that these stages must fuse somewhat in the human, since edema and hyperplasia were present in the periphery of the mesentery at the last operation when the third stage was present in the deeper parts.

SUMMARY

The literature and experimental work of retractile mesenteritis are here briefly

reviewed. This is followed by a complete case report of retractile mesenteritis associated with carcinoma of the gallbladder, in which carcinoma of the mesenteric lymphatic nodes are thought to be the primary cause of the production of the disease. The patient was operated upon at two different times and two stages of the development of the disease were observed for the first time in humans as seen in animals in whom the disease was experimentally produced; namely, the stage of hyperplasia and the stage of retraction by hardening of the fibrotic tissue and thus retraction of the entire mesentery. Significant differences in this process as compared with the process in animals were pointed out.

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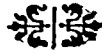
HYPERNEPHROMA ASSOCIATED WITH HYPERPLASIA AND METASTATIC CARCINOMA OF THE ADRENALS*·†

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HYPERNEPHROMA, the most common tumor of the renal cortex, while clinically a well established entity, is subject to much controversy pathologically. Grawitz, in 1883, first pointed out that the small yellowish nodules, occasionally found in the cortex and capsule of the kidney, are not lipomata at all, but adenomata arising from adrenal rests of the kidney, closely resembling the struma suprarenalis of Virchow. Birch-Hirschfeld, in 1892, suggested the term hypernephroma for all "Grawitz tumors," and though this nomenclature has gained a firm hold in the literature, the conceptions of what constitutes hypernephroma are as much in dispute today as they were several decades ago. Authorities like Lubarsch, Kelly, Kestenko and others, strongly supported the Grawitz theory, while first Sabourin and Cornil and then Sudeck, Stoerk and Wilson were its earliest opponents. Among the newer writers, Ewing is of the opinion that "the group of adrenal tumors of the kidney differs, as a whole quite distinctly from renal adenocarcinomata with clear cells." This view was also shared by Boyd. However, in the newer edition of his textbook on Surgical Pathology, Boyd has been converted to the belief that little is to be gained from the distinction between hypernephroma and renal carcinoma and classifies all these tumors under "the well established heading of hypernephroma, with the clear understanding, however, that the use of this name does not commit one to the adrenal theory of origin of these tumors." Bell, Cabot and others consider all hypernephromas as carcinomas of the renal cortex arising from epithelial origin, while Hinman restricts the term to tumors arising from adrenal rests.

Several substitute names for hypernephroma have been suggested, but only few established themselves in current use. Lubarsch introduced the name "hypernephroid tumor." MacKenzie employs the term hypernephroid "to include all those malignant tumors that resemble the adrenal cortex both in histology and structural arrangement." Others use it more indiscriminately to designate all types of parenchymal carcinoma of the kidney, and Young favors the abandonment of the confusing nomenclature altogether in favor of a group name, nephroma, "since it resembles the term in use, and commits us to no unproved theory."

The subject is not only of theoretical, but also of clinical, significance. Even if we were to accept the majority opinion of pathologists that all renal tumors arise from tubular epithelium and that the formation of tubules and papillae observed in hypernephroma does not coincide with the histologic picture of the adrenal cortex, there is still room for distinction between adenocarcinoma (hypernephroma) and alveolar carcinoma of the kidney. The distinction is not minimized by the fact that both pathologic forms may be found in the same tumor. Foulds and Braasch have pointed out that adenocarcinomas are composed of pathologically more differentiated cells and are also clinically more benign than the less differentiated alveolar carcinomas with solid cords without lumens, composed of granular or clear cells. The latter are more malignant, exhibit a

more rapid growth and form early metastases.

The case of adenocarcinoma of the kidney here reported makes the question of origin and differentiation even more pointed because it presents a rare combination of malignancy of the kidney with hyperplasia of the adrenal cortex, infiltrated with metastatic foci, and clinical manifestations of "virilism."

CASE REPORT

G. R., a white married woman, age 37, was admitted to the hospital on May 23, 1937, with the chief complaint of hematuria and general weakness. Except for the usual childhood diseases she had been in good health until about a year before, when she became aware of rapid loss of weight, intermittent hematuria and, for the previous five months, occasional renal colic and bladder distress, followed by passage of large blood clots. At about the same time she noticed hair growing on her face. Except for the last missing period, her menses which started at the age of 13 years, had always been regular and painless, lasting about six days. She had never been pregnant.

Physical examination revealed an extremely emaciated female, looking much older than her age, 145 cm. in height and 90 pounds in weight, with masculine features, sunken eyes and prominent cheek bones. Her cheeks and chin were covered with a beard-like growth, 1 to 2 cm. in length. (Fig. 1.) Her skin was dry and unelastic, hanging in folds. The mucous membrane was extremely pale. Her breasts were atrophied. Temperature on admission was 102°F. The heart was within normal limits, cardiac action was regular, at an increased rate, with a soft systolic murmur transmitted to the outer axillary line. The lungs appeared normal on percussion, with somewhat exaggerated vesicular breathing in the left intrascapular region. There were no râles and no pleural rub. Blood pressure was 102/60, and the pulse rate from 130 to 100. The shape of the abdomen was scaphoid. In the right upper quadrant a large nodular mass, firmly fixed, was palpated, which protruded from under the right costal arch, reaching downward for about three fingerbreadths and merging with the edge of an enlarged liver. There were no other masses

in the abdomen and no costovertebral tenderness. Vaginal examination was negative.

The urine was grossly bloody, alkaline in

FIG. 1. Hypertrichosis.

reaction with a fixed specific gravity of 1,010. Blood examination revealed 2,000,000 red blood cells and 40 per cent hemoglobin. White blood count was 14,300, with 90 per cent polymorphnuclear neutrophiles; 10 per cent lymphocytes; 87 per cent segmented; 3 monocytes; 4 stab; 1 basophile. Blood chemistry was: glucose 88.7 mg. per cent; urea 18.2; creatinine 1.66; uric acid 3.98; nonprotein nitrogen 40.2; cholesterol 176; calcium 11.0; phosphorus 3.86; chlorides in whole blood 486.0, in plasma 594.2 and in cells 298.0; CO_2 capacity 66; icteric index 4.62. Blood urea clearance test was 34.2 per cent. Wassermann and Kahn tests were negative. Urinary output in twenty-four hours ranged between 30 and 50 ounces.

Cystoscopy under caudal anesthesia, after evacuation of a considerable number of blood clots, revealed a bladder of small capacity and deeply congested, especially in the trigonal region. An organized blood clot was removed from the right orifice with a cystoscopic forceps before inserting a No. 6 ureteral catheter. There was no obstruction in either ureter, and pure blood was aspirated from the right kidney. The left catheter drip was normal and the specimen slightly cloudy. Indigo-carmine injected intravenously gave a two plus blue return from the left kidney in fourteen minutes, and none from the right kidney in twenty minutes. Urine from

bladder and cystoscopic specimens contained staphylococci on smear and culture.

X-ray examination showed a large staghorn

FIG. 2. Retrograde pyelogram of right kidney. Calculi in left renal pelvis.

calculus in the left kidney and a soft indefinite mass in the right side with no psoas markings. Intravenous urography revealed some dye in the sacculated upper calices of the left kidney in twenty minutes, the entire pelvis, the middle and lower calices being occupied by the calculus. No dye appeared in the right kidney one hour after intravenous injection of diodrast. On retrograde pyelography (Fig. 2) the right kidney appeared very much enlarged, the pelvis was dislocated in the direction of the upper pole with partial obliteration of the middle and complete obliteration of the lower calices. The proximal portion of the ureter was displaced mesially. The entire left pelvis was filled with the aforementioned calculus which formed an almost exact mould of the renal pelvis and calices. X-ray of the chest revealed an area of opacity at the midperiphery of the left lung field, with a smooth curvilinear convexity at the mesial aspect of the shadow, suggesting a metastatic lesion. No metastases were found in skull and long bones.

The above findings suggested neoplasm of the right kidney with metastases in the lungs, and staghorn calculus in the left renal pelvis. The combined lesion of both kidneys in the presence of metastases, poor renal function and poor general condition precluded any possibility of surgery and palliative treatment was resorted to. The patient received repeated blood transfusions, intravenous glucose therapy and general measures, all of which failed to affect her condition or to raise her red count figures. She grew perceptibly weaker, became drowsy and listless and in the terminal week developed a right-sided septic parotitis. She expired July 2, 1937, forty-one days after admission.

Autopsy. The abdomen was opened by a median incision from the xyphoid process to the symphysis. The panniculus adiposus measured less than 0.5 cm. in thickness. The right diaphragmatic dome was at the fourth intercostal space, the left at the fifth intercostal space. The liver edge was below the costal margin in the midclavicular line. The anterior pole of the spleen was at the left costal margin. The bowels were in a state of moderate constriction. In the anatomic place of the right kidney there was a tumor mass the size of a child's head, covered by a firm capsule and attached by numerous, easily torn fibrous adhesions to the neighboring organs, especially to the edge of the liver and to the hepatic flexure of the colon. The descending part of the duodenum was covered by the right edge of the tumor mass. The heart was essentially normal, but the lungs showed numerous well defined metastatic nodules from 5 to 50 mm. in diameter, most of which were subpleural. Metastatic invasion of the tracheobronchial lymph nodes was seen. Liver was considerably enlarged and very flabby. It measured 29 by 19 by 9 cm., and weighed 1836 gm. The cut surface had a very definite yellow tint and bulges. The gallbladder contained a large black, mulberry shaped calculus, of cholesterol variety. The spleen was considerably enlarged, measuring 15.5 by 8 by 4.5 cm., and weighed 280 gm. The follicles could be seen with difficulty. The splenic vessels showed no gross changes.

The right kidney appeared as a tumor the size of a child's head, the anatomic relations of which have already been described. It measured 19 by 8 by 10 cm., and weighed 860 gm. It was surrounded by a very firm, highly vascular capsule, which itself was riddled with

multiple, pea-sized tumor nodules. The adrenal gland was well defined and firmly attached to the posterior aspect of the kidney. The fibrous

of the renal pyramids were flattened. The blood clots in the pelvis continued into the ureter, which ran along the medial aspect of the tumor

Fig. 3. Gross specimen of kidneys, ureters and bladder. Note tumor of right kidney, compressed pelvis, attached right adrenal; calculi and metastatic nodules in left kidney.

capsule could only partially be removed from the surface of the tumor. On section, the entire lower half of the kidney was occupied by a large tumor mass, which measured 15 by 9 cm. and was indistinctly delimited from the renal tissue. The tumor mass was of bright yellow color with many red areas. It was of moderately firm consistency, but showed large, soft, pinkish-yellow, mottled, depressed areas of necrosis and degeneration. Many wide blood vessels were seen within the tumor mass. The latter also invaded the renal pelvis, which was distended, but almost entirely obliterated by the tumor. The non-obliterated parts of the pelvis were filled with a large blood clot. The renal parenchyma formed the upper portion as a rather narrow layer along the convexity of the whole mass. Its surface was riddled with tumor nodules of 1 to 2 cm. in diameter, and similar nodules were found on the cut surface. There was no sharp outline between cortex and medulla. Both showed a pinkish-yellow color. The calices were markedly dilated and the tops

mass, imbedded in the firm, fibrous capsule of the tumor. The mucosa of the ureter was swollen and diffusely reddened. The right renal vein was entirely obliterated by the tumor masses, which extended into the vena cava. The intima of the latter, in the vicinity of the opening of the right renal vein, was covered by flat, yellow, indistinctly outlined tumor masses.

The left kidney measured 12.5 by 5 by 5 cm., and weighed 260 gm. Its capsule stripped with ease and revealed a smooth surface, which showed multiple, elevated, sharply outlined, round, yellow tumor nodules from 0.1 to 1.5 cm. in diameter, some of which had central necrosis. The surface of the renal tissue was pinkish-gray. On section, a large amount of thick, yellow, cloudy pus poured out of the renal pelvis. The latter was markedly distended and contained three calculi, the largest a perfect cast of the lower half of the renal pelvis, which it obliterated entirely. The stone measured

4.1 by 1.6 by 1 cm., was of firm consistency, had a rough, red and yellow surface and was adherent to the renal pelvis. The upper part of

Of the gastrointestinal tract—the sigmoid showed multiple diverticula, measuring 2 to 5 mm. in diameter and of varying depths.
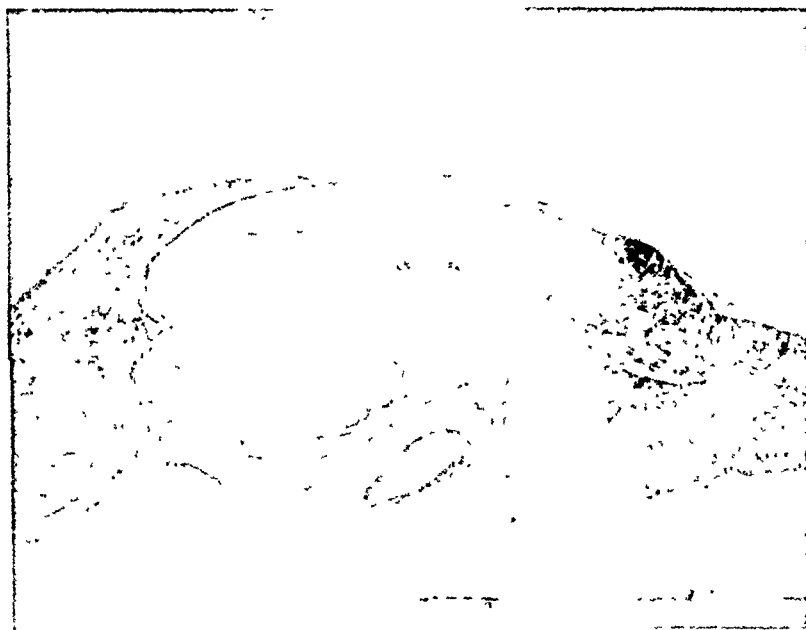
FIG. 4. Left adrenal showing a large metastatic node and hyperplasia of the cortex.

the pelvis was dilated, ovoid in shape and obliterated by a firm, yellow calculus the shape and size of a pigeon's egg. The third calculus was found in a dilated calyx near the lower pole of the kidney. The mucosa of the renal pelvis was somewhat thickened and rough, but showed no marked inflammatory changes. The remaining part of the renal tissue showed a partly distinct and partly indistinct outline between cortex and medulla. The renal parenchyma was flabby and of yellowish-red color. There were multiple round tumor nodules on the cut surface. The vessels of the left kidney showed no abnormalities.

The bladder was contracted. There was diffuse reddening of the mucosa, which was especially marked at the trigone. Both ureters opened at the normal site with slit-shaped openings.

Both adrenals were large. The left (Fig. 4) weighed 24 gm. and the right about 20. The right adrenal was firmly adherent to the capsule of the right kidney tumor. On section, white distinctly outlined tumor nodules 3 to 6 mm. in diameter were found in each adrenal. The adrenal tissue itself showed a somewhat undefined pale cortex. The medulla was gray and homogeneous.

Indurated fecal stones were found in many of these diverticula and the mucosa often showed small ulcers 3 to 7 mm. in diameter. There were also a few round ulcers independent of the diverticula. All ulcers had sharp, slightly ragged edges. Some of them extended almost through the muscularis propria while others were more shallow. Scattered over the serosal surface of the colon were a few tumor nodules 0.5 to 1 cm. in diameter and sharp in outline. Similar nodules were found in a few places in the submucosa of the sigmoid. They all had the gross characteristics of metastatic foci. The rectum showed a diffuse, reddish-brown discoloration of its mucosa. The mesenterium contained many, slightly enlarged, rather soft lymph nodes. On section they were whitish and homogeneous.

The genital tract was essentially normal.

Microscopic Findings. Sections of the right kidney (Fig. 5A and B) showed a variety of histologic pictures. For the most part, the cells were large polyhedral with small hyperchromatic nuclei and abundant granular cytoplasm. They were arranged in solid medullary masses or showed a distinct lumen in the center. Frequent papillary formation was seen throughout. There were also small areas where the cyto-
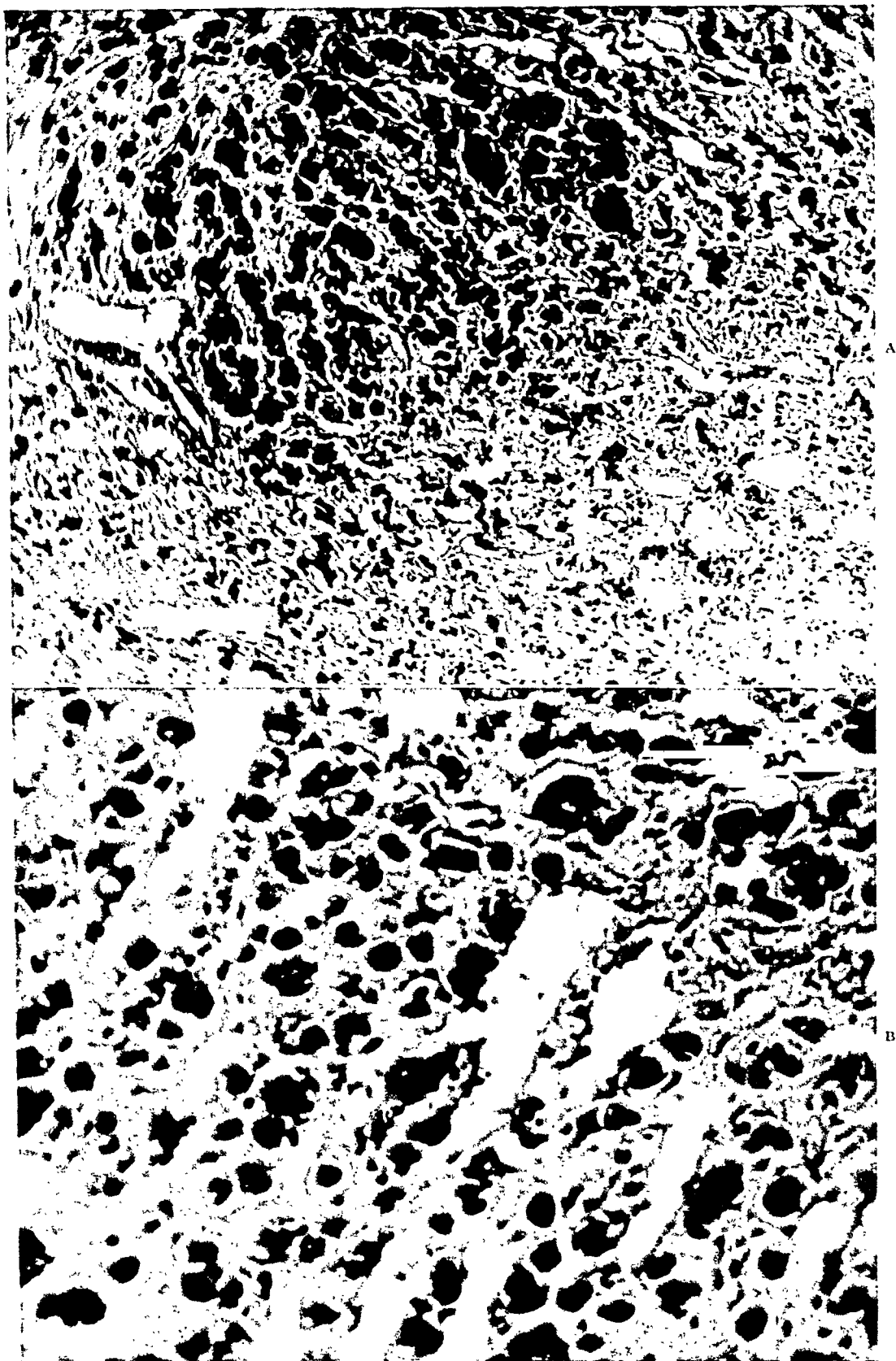
Fig. 5. A, low power photomicrograph of section from kidney tumor (clear cell and granular cell type). B, high power magnification of section from kidney tumor.
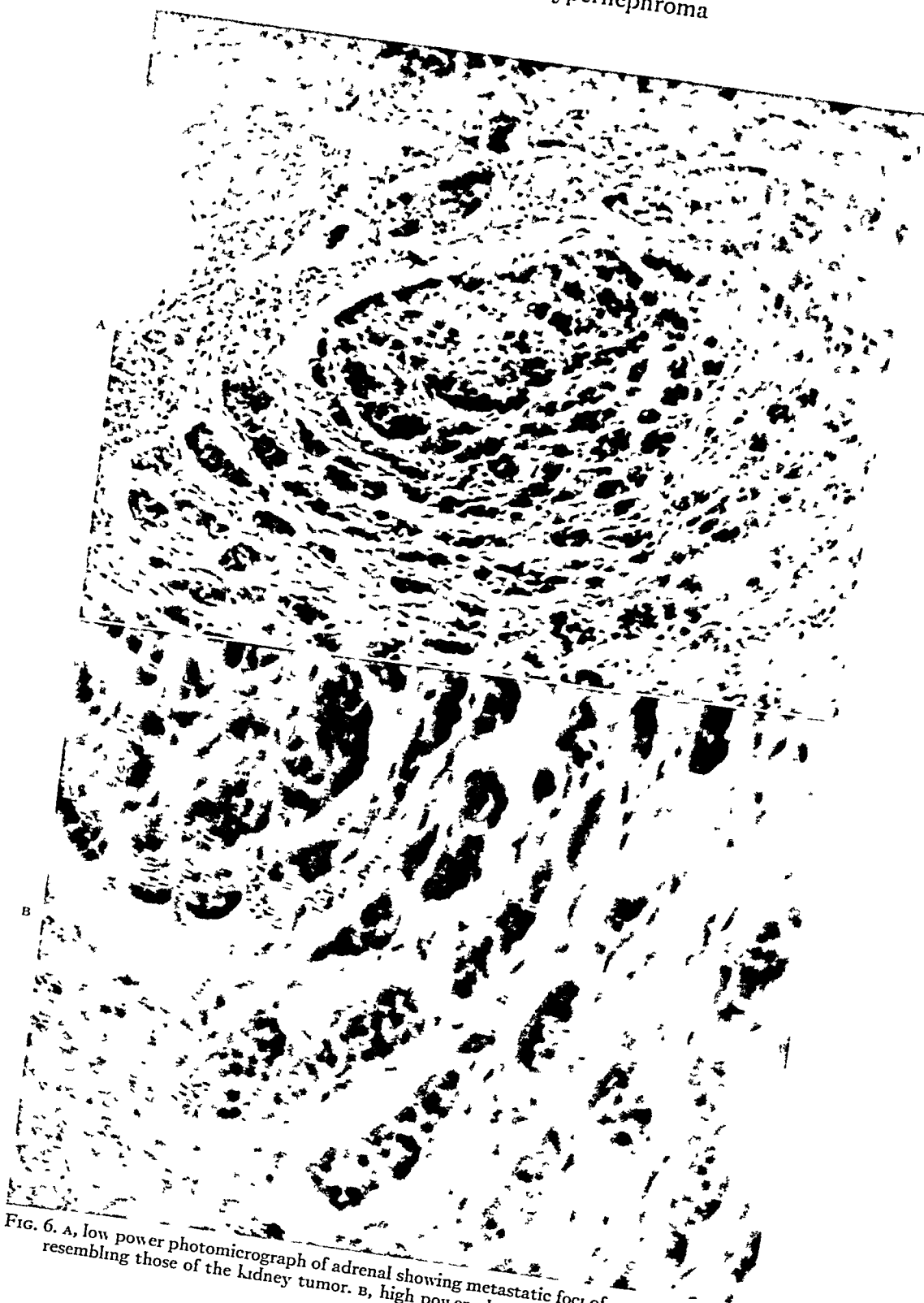
FIG. 6. A, low power photomicrograph of adrenal showing metastatic foci of anaplastic growth resembling those of the kidney tumor. B, high power photomicrograph of adrenal.

plasm of the cells was clear, giving a typical histologic picture of the "clear-cell" type carcinoma. The tumor was very vascular, and the connective tissue stroma was relatively scant. Tumor emboli were also seen.

The metastatic areas in the lungs and left kidney showed essentially the same picture, except that there was a greater anaplasia and atypism. There were numerous cells with giant nuclei and places where a sarcomatous-like picture was seen. The same was true of the metastatic areas in the adrenals. (Fig. 6a and b.) The non-involved areas of the adrenals show a generalized hyperplasia of the cortex. Hypertrophy of the central vein was also seen.

COMMENT

This case presents something of a pathologic museum incorporated in a single body. Aside from other lesions, there is the not very common association of a diffusely metastatic hypernephroma (carcinosis) and calculous disease (calculosis) in the opposite kidney, in the gallbladder and in diverticula of the sigmoid. However, the most striking feature which is scientifically intriguing as well as uncommonly rare, is the association of symptoms of virilism with hypernephroma.

The first question which arises is: are these findings in the nature of a mere coincidence or of a more consequential nature? We believe that in a general way, at least, the latter conclusion can be easily dismissed. For, whatever theory one favors as to the origin of hypernephroma, it seems an established fact that hypernephroma, of itself, produces neither virilism nor any of the other manifestations commonly associated with adrenal tumor. Indeed, this very lack of the androgenital changes characteristic of adrenal involvement is one of the strongest arguments against the adrenal rest origin of hypernephroma. Genital changes occur in several other conditions affecting the endocrine system. Chief among them are the basophilic adenomas of the anterior pituitary, the arrhenoblastomas and, rarely, granulosa cell tumors of the ovaries, and tumors of the pineal body. In our case, none of those

conditions were found clinically or at autopsy, and the only remaining source of origin must therefore be sought in the adrenals proper.

The adrenocortical syndrome presents a complex of genital and metabolic changes which have a well established clinical record. In adrenal tumor there is an increase in androgenic hormone secretion and disturbances of the electrolytic metabolism, especially in the sodium-potassium ion concentration in the blood serum. Some of the manifestations of adrenocortical tumor in females are: precocious menstruation before, and amenorrhea after puberty; masculine voice, hypertrichosis, hypertrophy of the clitoris, striae atrophicae of the skin, acne, hypertension, diabetes (frank or latent), premature closure of the epiphyses, and osteoporosis. Such changes have been observed in cortical tumors of the adrenals—in the adenomas and carcinomas—and in the nonneoplastic hyperplasias, especially nodular hyperplasia of the adrenal cortex.

However, there are exceptions to every rule and in this case the exceptions seem to be the rule. Indeed, it is a rare case which bears all the earmarks of that vast symptomatology. Some or all of these manifestations may fail to materialize, even in well established adrenocortical tumors, and still more so in the simple hyperplasias. In our case too, most of the above mentioned symptoms were missing, but the beard-like hypertrichosis, the prominent masculine features and perhaps also the history of marital sterility, when correlated with the findings at autopsy, point strongly to adrenocortical hyperplasia as the causative factor. How much these symptoms were aggravated or brought into clinical prominence by the metastatic invasion of the cancerous growth from the kidney is difficult to decide. If we were to rely on the case history, the facial hair growth seems to have become more noticeable some six to eight months previous to hospital admission. However, too much reliance cannot be put in this kind of reference, and

we shall have to wait for reports of similar cases to clear up this interesting point.

SUMMARY AND CONCLUSION

1. A rare case is presented of hypernephroma associated with multiple calculous disease, adrenocortical hyperplasia and metastatic carcinoma of both adrenals.

2. The origin of hypernephroma is discussed and the current pathologic theories reviewed.

3. A most unusual feature of the case was the presence of marked symptoms of virilism and pronounced facial hypertrichosis.

4. Virilism as one of the manifestations of the adrenocortical syndrome, observed in tumors and hyperplasias of the adrenal cortex, is due to increased secretion of androgenic hormones by hyperfunctioning suprarenals.

5. Hypernephroma of the kidney as such does not produce changes in the secondary sex characters.

6. The question of metastatic carcinoma of the adrenals in relation to the symptoms of virilism is left open for discussion.

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Correction: Dr. Elmer J. Ball, of Los Angeles, who wrote on "A New Treatment of Ganglion," which appeared in our December, 1940 issue, page 722 wishes to clarify his statement regarding the amount of solution to be used. We quote from his letter as follows:

"I do not believe my article is entirely clear as to the amount of solution; 2 cc. would be the maximum, of course, depending upon the size of the ganglion. The case reported told of 2 cc. of fluid injected into a ganglion 2 cm. in diameter. In such a case 3 to 5 minims would be sufficient—this, of course, is to be accomplished without rupturing the ganglion.

"I would like to emphasize the importance of not rupturing the ganglion and adjusting the dosage to the size of the ganglion. Two or three minims is sufficient for the small ganglion on the wrist."

ESOPHAGOPLEURAL FISTULA: A COMPLICATION OF EMPYEMA

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THAT esophagopleural fistula is a very uncommon occurrence is easily corroborated by the scarcity of available literature on this subject.

Gott[1] reviewed forty cases in 1933 and added four cases of spontaneous rupture of esophagus. This was again reviewed in 1938 by Benson.[2]
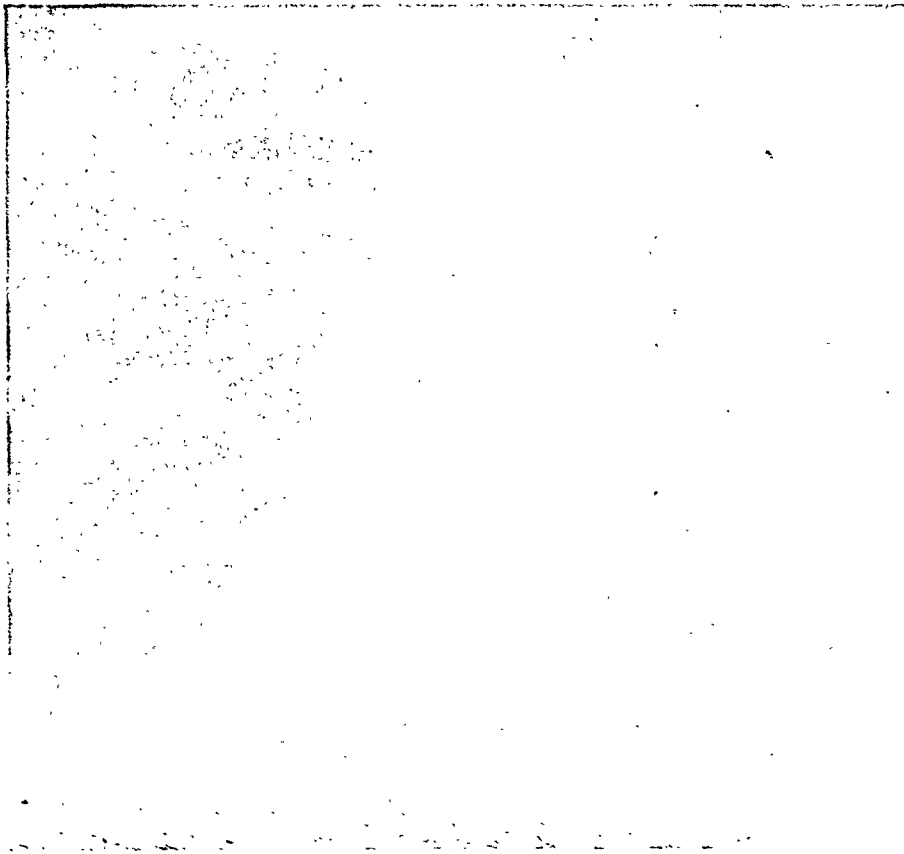
Fig. 1. View of chest showing empyema left, before aspiration.

Such fistulae, when due to foreign bodies, extension into the pleural cavity by carcinomatous ulceration, simple ulceration or diverticulae, or spontaneous rupture associated with severe vomiting, are not too uncommon. The symptomatology in these cases consists of shock, severe substernal pain, subcutaneous emphysema, marked dyspnea and cyanosis. Death may occur within twenty-four to forty-eight hours from a fulminating mediastinitis and pleuritis or secondary pressure pneumothorax.

Most of these reports deal with fistulae originating within the esophagus. Perforation of the esophagus into the pleural cavity, due to purulent pleural infection, diagnosed casually by the appearance of food particles on previous thoracotomy dressings or during irrigation or aspiration of an empyema, is very rare. Only twelve such cases can be found in a review of the literature to date. Kanter and Madoff[3] report one such case besides their own, having its origin from tuberculous caseating

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mediastinal lymph nodes; these are not included in the study but tend to show the rarity of involvement of the esophagus from pleural infections.

were carried out. On June 4, 1936 in aspirating the empyema cavity orange pulp was removed. The patient had had orange juice two hours before. She recalled that she had had a rather
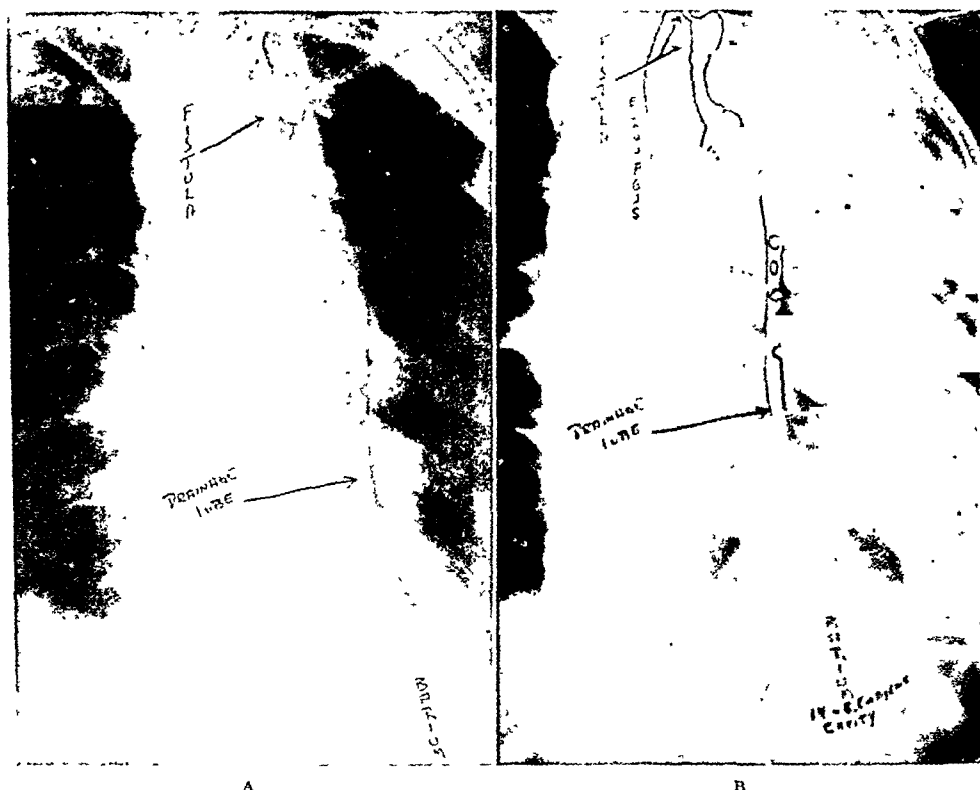
FIG. 2. A, showing barium in esophagus and outline of fistula leading to pleural space and empyema cavity. B, showing inking in of fistula and esophagus and barium in empyema cavity.

CASE REPORT

A negro female, age 30, school teacher by occupation, complained of pain in the left chest, a dry cough and increase in temperature. She had had "flu" about six weeks before and had been dismissed by her physician after three weeks' treatment. Three weeks later she began to have cough and pain in the left chest.

Examination on May 27, 1936 showed limited expansion of the left chest, dullness to flatness of the left lung posteriorly and absent breath sounds, with tactile and vocal fremitus absent. There was definite displacement of the heart to the right.

X-ray study of chest showed (Fig. 1) complete opacity of the left thorax to the level of second rib. The mediastinum was displaced to right.

Thoracentesis was done and a drainage tube inserted between the eighth and ninth ribs. Aspiration and irrigation with normal saline

severe coughing spell after eating cornbread at noon. No pain was noted.

Fluoroscopic study of the esophagus with barium and x-ray studies on June 4, with the patient lying on her left side and her head elevated to a 45 degree angle, showed the barium passing into esophagus and down to upper border of the aortic arch where much of it was seen to pass into the pleural space of the left chest. The rest of the meal passed normally down the esophagus into the stomach. (Figs. 2 and 3.)

A Levine tube was passed through the left nostril and secured with adhesive tape. The patient was tube fed thereafter, with marked improvement resulting. On June 18, the tube was removed and barium was given again. A fistula about the size of an ordinary lead pencil still communicated with the left pleural cavity.

Since there had been considerable gain in weight and general improvement in well being, the tube was replaced for another two weeks.

On July 2, 1936, four weeks after the original finding of fistula, barium was again given and no evidence of fistula was found. The catheter

to six years after drainage, but in most cases the observation was made after original aspiration in about twenty days. The

FIG. 3. Semilateral view, showing barium in esophagus and fistula with barium in empyema cavity.
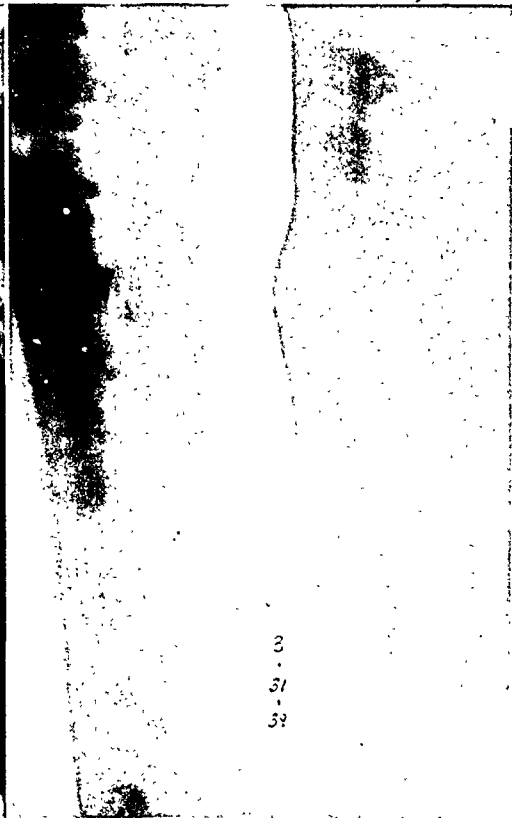
FIG. 4. Two and one-half years after closure of esophageal fistula, showing no constriction and normal filling esophagus.

in the pleural space was still present. On October 6, no signs of stricture or obstruction of esophagus, and no signs of fistula were seen. In March, 1939, barium could pass through the esophagus with no obstruction, spasm or fistula. The lung fields were clear, the patient had gained 45 pounds and was free of symptoms. (Fig. 4.)

In a review of the literature we have found twelve reported cases following empyema, the first that of Voelcker in 1891. In Table 1, a summary of the 12 cases and the additional one here reported is given.

The ages ranged from 2½ to 52 years, with an average of 14.8. Only three patients were over 15 years of age and the majority were under 10. Eight patients were male and two were female; in two sex was not given. The left side was involved in nine instances and the right in four. Food or ingested material was noted from two days

duration before healing or death was as short as two weeks and as long as nine months. Rib resection was done in all cases reported except that of Voss and our own. Tube feedings were first done by Ballin and Saltzstein in 1922, but of the thirteen cases tube feeding was done in only five. Gastrostomy was done in three instances and rectal feeding in one. X-ray studies were made in eight and the lesion confirmed. Of the thirteen cases reviewed, five resulted in death, eight in recovery without any demonstrable ill effects, except for one patient who showed marked retraction of the affected side after healing of the fistula.

Only one death occurred in the five cases where tube feeding was used and this was a chronic case of six years' duration. Recovery in this group was seen in a short while—from two to four weeks. There are

TABLE 1

Case	Age	Sex	Side of Empyema	Day Food Noted	Duration	Kind of Treatment	X-rays	Results
1. Voelcker,[4] 1891	6½	M.	Left	6 months	9½ months	Rib resection	No	Died
2. Thrusfield,[5] 1901	4½	M.	Right	Empyema necessitalis 4 days later	2 weeks	Rib resection	No	Died
3. Arquellada,[6] 1920	9	M.	Left	?	2 weeks	Resection and tube	Yes	Cured 3 weeks
4. Ballin and Saltzstein,[7] 1922	15	M.	Right	8 days	3 weeks	Rib resection and Rehfus tube	Yes	Cured 3 weeks
5. Fonte,[8] 1922	52	M.	Left	1 to 2 yrs.	Months?	Resections; irrigations	Yes	Cured, with retraction of chest
6. Voss,[9] 1923	8	M.	Left	2 days	3 weeks	Esophageal tube feedings	No	Cured
7. McCormick,[10] 1928	Not stated	..	Right	6 years	8 months	Resection four times; tube and gastrostomy	Yes	Died
8. Acuna Bettinotti,[11] 1930	2½	F.	Right	Day of aspiration, milk and pus	?	Rib resection; gastrostomy	No	Died
9. Mikula,[12] 1931	11	?	Right	Day of aspiration	5 months	Resection; gastrostomy	No	Cured
10. Wall,[13] 1932	11	M.	Left	11 days	2 months	Resection, rectal feedings	Yes	Cured
11 Caubarrere,[14] 1934	8	?	Left	6 days	2 months	Resection	Yes	Cured
12. Blauvelt,[15] 1938	27	M.	Left	27 days	9 months	Resection	Yes	Died
13 Torbett, 1936	30	F.	Left	8 days	4 weeks	Tube feedings, thoracotomy	Yes	Cured

no apparent contraindications to this method of treatment.

The etiology is unknown. Probably the process spreads to the mediastinum and esophagus by direct extension in large massive empyemas, causing secondary local erosion into the esophagus. No great distress or discomfort is noted, as is common in conditions arising in the esophagus and spreading to the pleural cavity.

SUMMARY

1. A case of esophagopleural fistula as a complication of empyema is reported.

2. A brief review of cases in the literature is given.

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MULTIPLE CRANIAL LESIONS WITH PORROPSIA AND HYPERACUSIS*

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THE following case has been of unusual interest to us for several reasons. First, the co-existence of osteomyelitis of the skull with an underlying epidural abscess and a chronic subdural hematoma is, we believe, very rare. Second, the patient presented a combination of two uncommon symptoms—porropsia (objects appearing as though they were at a distance) and hyperacusis. Finally, the patient responded very satisfactorily to treatment.

CASE REPORT

History. R. N., a white male, aged 14, was admitted to the Western Pennsylvania Hospital, January 3, 1938. For five years the patient had suffered from osteomyelitis of the pelvis and left femur and during that time had developed metastatic infection of several other bones. In June 1937—seven months before the present admission—he complained of an occasional headache. At about the same time a slightly tender swelling appeared in the occipital region. After one aspiration of pus from beneath the scalp the swelling slowly receded.

The boy was seen by one of us (M. H. W.) in November, 1937. At that time he complained that for about twelve to eighteen months objects in his field of vision occasionally had appeared as though they were at a considerable distance. As the patient described it: "Things look as though I were looking through the wrong end of a telescope." These attacks occurred more commonly at night, but seldom more than once a night. To relieve this symptom he would walk around for a short time and wash his face with cold water—a procedure which invariably caused hyperacusis, or as he put it: "Things all sounded terribly loud." He also complained that for the previous three weeks his head hurt whenever he shook it.

Neurologic examination at that time was entirely negative. At the time of admission to the hospital, January 3, 1938, the attacks of porropsia and hyperacusis were still present, the headaches had become more severe, and the occipital swelling had gradually recurred.

Examination. Physical examination was negative with the exception of the scars of previous operations, a draining sinus on the inner side of the left thigh, and a soft, fluctuant, tender, dollar-sized swelling in the midline about 4 cm. above the occipital protuberance.

Neurologic examination January 5, 1938, showed early changes in the optic fundi, including congested veins and slight blurring of the disc margins; slight pyramidal tract signs on the left, namely, deviation of the tongue to the left, lagging of the left angle of the mouth, slight predominance of the left arm reflexes and left Achilles' reflex.

The spinal fluid pressure was 18 mm. of mercury. The fluid contained 5 W.B.C. per c. mm., no R.B.C. and no globulin.

Beneath the soft tissue swelling the skull showed increased density in the roentgenogram. The change, though slight, was considered sufficient to suggest a diagnosis of osteomyelitis. (Fig. 1.)

The clinical diagnosis was osteomyelitis of the skull with epidural abscess. Operation was advised.

First Operation. On January 6, 1938, an occipital craniectomy was performed (S. N. R.). Two encapsulated and separate abscesses were found in the scalp and drained. The bone was found to be roughened and sclerosed and yet so involved by infection that when the periosteum was rolled back, pus broke through spontaneously from the underlying epidural abscess. A square piece of bone measuring about 2 by 3 inches around the involved area was removed. It was estimated that 15 to 20 cc. of pus escaped from the epidural abscess at this time.

Since the upper margin of the exposed bone appeared infected, an additional strip about ½ by 2 inches was removed with a rongeur.

no gas entered the ventricular system, and a ventriculogram was decided upon. Because of the occipital infection, burr holes were made
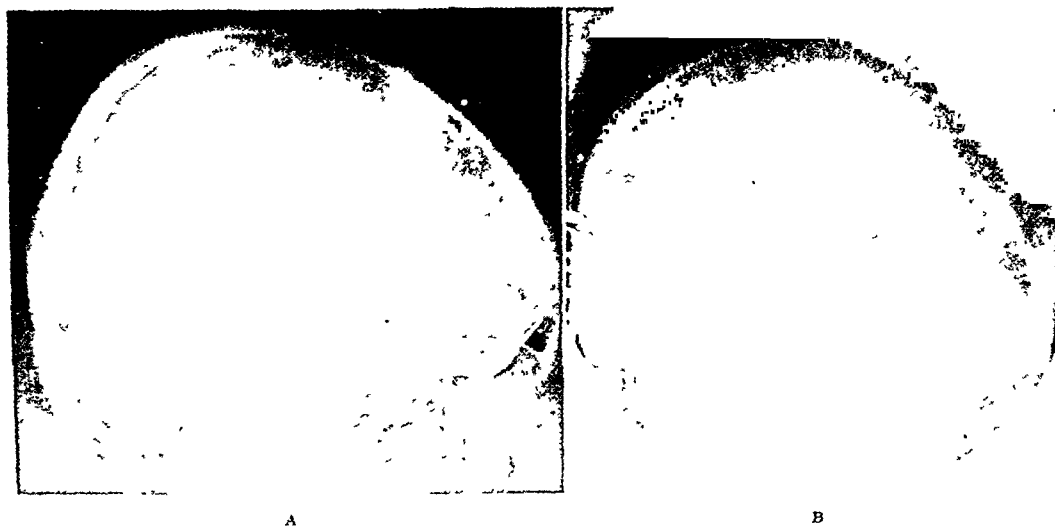
FIG. 1. Preoperative lateral and basal skull films showing the increased density in the parieto-occipital region.

Arrangements were made for dakinization and the scalp was closed loosely.

The surgical recovery was uneventful, but the patient's headaches and vomiting continued. Lumbar puncture January 14, 1938, showed a spinal fluid pressure of 18 mm. of mercury and a fluid containing 2 W.B.C. per c. mm. and 30 R.B.C. per c. mm.

Nine days after the craniectomy the drainage from the pelvic sinus stopped, leaving the boy free of symptoms with the exception of those referable to the head, namely, bouts of vomiting, headache and an occasional brief attack of porropsia.

On January 16, 1938, the patient was quite drowsy and sleepy, complaining of severe headache. The vessels of the right fundus were congested, and the margins of the left disc obliterated. There was slight weakness of the left face, and the deep reflexes of the left extremities were slightly more active than those on the right. The abdominal reflexes on the left were somewhat diminished. No Babinski was present, but a modification was found bilaterally.

It was felt that the patient might have a right cerebral abscess beneath the occipital infection, but an air injection was planned to confirm the impression before attempting any direct exploration.

Second Operation. On January 17, 1938, an encephalogram was attempted cautiously, but

in the frontal region 3 cm. on either side of the midline. On the right side a subdural collection of old blood was found. The skull opening was then enlarged, and the entire contents of the hematoma evacuated by washing and aspiration. An opening was made in the inner membrane permitting a free flow of cerebrospinal fluid in and out of the sac and the wound closed without drainage.

The patient was immediately relieved of his headaches and vomiting. Slight weakness of the left lower face and a slight hyperreflexia on the left persisted for about two weeks. During this time the papilledema gradually subsided, until the eye grounds returned to normal. On one or two occasions, the boy still complained of transitory porropsia, saying that things looked small and far away.

After discharge, the patient was given disulfanilamide for three months. He also took considerable quantities of vitamins A, B, and D. His general health improved rapidly, and he gained a great deal in weight and height. Six months after the operations his occipital wound ceased to drain, and he was symptom-free for the first time in five years.

A recurrence of the osteomyelitis developed in the left femur in November, 1938 (ten months after the cranial operation) but healed after incision and drainage performed by Dr. M. A. Cohen.

On several occasions in March, 1939, the patient was troubled with brief bouts of blurred vision followed by headache for one or

the fundi, and left hemiparesis at this time seemed to confirm this impression. However, it was obvious that exploration for a
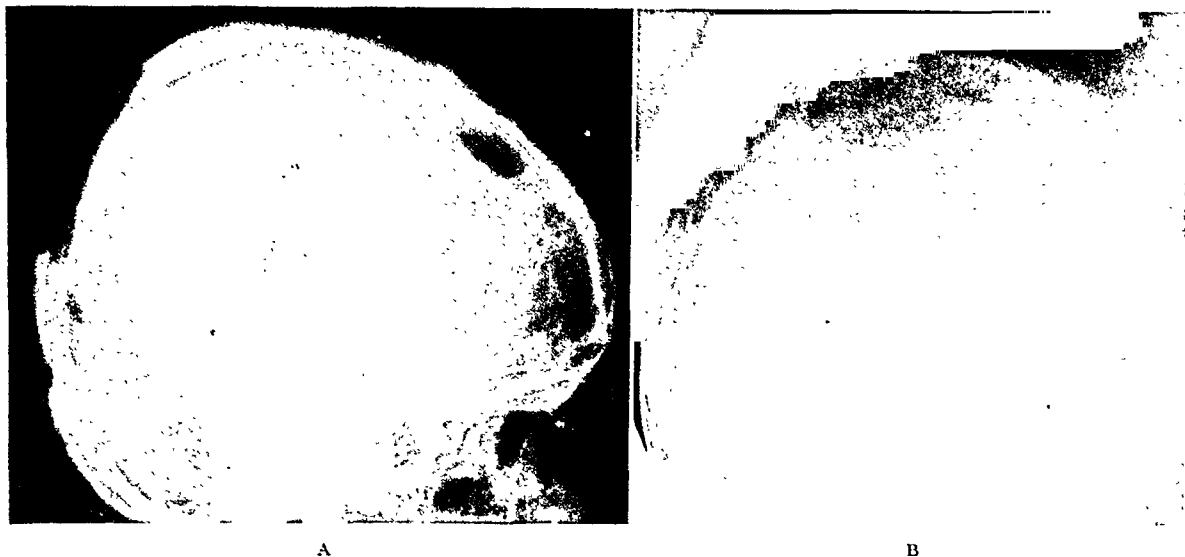
FIG. 2. Films taken soon after the second operation. The parieto-occipital bone defect and the right frontal opening through which the subdural hematoma was drained are apparent.

two hours, but there were no attacks of porropsia or hyperacusis.

When the patient was last seen May 22, 1939, he was symptom-free, and objective neurologic examination was negative. Several large plaques of regenerating bone had nearly filled the occipital skull defect. (Fig. 2.)

DISCUSSION

This case is of interest because of the unusual combination of metastatic osteomyelitis of the skull with chronic subdural hematoma and the attendant diagnostic difficulties, the absence of a definite history of preceding cranial trauma and the presenting symptoms of porropsia and hyperacusis.

The diagnosis of osteomyelitis of the skull was not difficult, although the process proved to be more extensive than the Roentgen films suggested. Furthermore, the presence of an epidural collection of pus was correctly diagnosed because of the patient's preoperative symptoms and signs. When the headaches and vomiting failed to disappear after the removal of the bone infection and underlying exudate, it was suspected that we were dealing with an intracranial lesion, perhaps an abscess. The development of drowsiness, changes in

brain abscess through the infected area was entirely unsafe, and that even a ventriculogram through occipital burr holes was hazardous. Accordingly, an encephalogram was attempted in spite of the known high intracranial pressure. No gas entered the ventricular system, and the slowing pulse and respiratory rates indicated that the procedure added somewhat to the medullary compression.

The patient was then taken to the operating room and preparations made for a ventricular drainage through burr holes in the frontal region. The left ventricle was drained first; but when an attempt was made to expose the right frontal cortex, the hematoma was entirely unexpectedly encountered and readily drained.

Even in retrospect it was difficult to obtain a history of previous trauma to the head in this case. The only history of this sort given was that of being struck on the head by a softball about eighteen months prior to admission. The patient did not have the usual complaints of subdural hematoma, nor did he present any signs to suggest such an intracranial lesion. In fact, at the first examination by one of us (M. H. W.) about six weeks before admis-

sion, he presented no neurologic findings whatever.

A review of the literature for the past fifteen years fails to reveal a similar case, although some cases of cerebral abscess or abscess in other parts of the body in connection with subdural hematoma are mentioned. Furlow[1] reports the case of an old man of 65 with subdural hematoma who had a fracture of the posterior wall of the frontal sinus with an area of infection, from which a sinus extended to a large abscess in the right frontal lobe. In Cabot's[2] case, the pathologic process consisted of a sac containing bloody fluid and purulent material which was sterile on culture. Hada, quoted by Sherwood,[3] reported a case in a child fourteen months of age who suffered with pertussis. Following a whoop he had a convulsion, and five days later, lumbar puncture showed blood and pus in the spinal fluid. Kaplan's[4] case IV developed an abscess of the lung during her convalescence, but the lesion healed with postural drainage. Kaplan does not devote any discussion to the abscess.

Sherwood cites cases, one by Chambers and the one previously mentioned by Hada. In Chamber's case the condition was diagnosed as pachymeningitis, supposedly in connection with mastoiditis and chronic abscess. Hada believed that infectious diseases played a major part in the etiology of pachymeningitis. Zehnder[5] speaks of meningitides with frank hemorrhages, also of bleeding dura following catarrhal infection with sinusitis.

Can we say in this case that the osteomyelitis of the skull and the abscess overlying the dura played a part in the formation of the subdural hematoma? There is no way of answering this question definitely. Neither the fact that the patient presented no neurologic findings only six weeks before admission, nor the eighteen month interval between the supposed trauma and the development of the symptoms militate against the theory that it was the trauma that was primarily responsible for the subdural hematoma. All modern writers agree that trauma is the cause in practically all the cases of subdural hematoma, and that the latent period may extend from a week to three years or longer. Gardner,[6] Kaplan,[4] Jelsma,[7] Furlow,[1] and Zollinger and Gross[8] all stress this point of view.

The visual and auditory disturbances which occurred in this case were difficult to interpret. In the literature references to micropsia (objects appearing small) and porropsia (objects appearing at a distance) are rare and references to the combination of porropsia and hyperacusis are extremely rare.

Higier[9] is the only one to report such a combination of symptoms. His patient, a woman, had a pituitary adenoma. However, Higier believed that the lesion responsible for these two symptoms probably was in the calcarine fissure or cuneus. Higier diagnosed his case as one of "epilepsia tarda endocrina hypophysotoxica." Both Higier and Singer[10] regard porropsia as merely a phase of micropsia. The latter states that "in addition to the objects being small, they also seem far away." Micropsia usually occurs in choroidoretinitis, especially of the syphilitic type. Ball[11] in his discussion says: "Syphilitic choroidoretinitis is a frequent cause of micropsia and megalopsia."

We are unable to offer any localization for the lesion responsible for these two complaints in our case. Since the symptoms disappeared soon after the second operation, we think it safe to assert that they were contiguous symptoms due to pressure either from the subdural hematoma or possibly from the epidural abscess.

SUMMARY

1. A case of occipital metastatic osteomyelitis of the skull with an epidural abscess associated with a right sided chronic subdural hematoma is reported.

2. Among other symptoms the patient complained of porropsia and hyperacusis. A search of the literature reveals only one

other case presenting this combination of symptoms.

3. Surgical extirpation of the infected bone and the discovery and drainage of the subdural hematoma eleven days later resulted in complete relief of the patient's symptoms. When last seen, sixteen months after operation, the patient was free from symptoms, neurologic examination revealed no abnormalities, and the osteomyelitis of the skull was completely healed.

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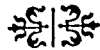
The commonest apical murmur is the cardio-respiratory and this is usually well heard far into the axilla, and is often conspicuous at the angle of the left scapula.

From—"The Soldier's Heart and the Effort Syndrome"—by Thomas Lewis (Shaw and Sons Ltd.).

UNUSUAL COMPLICATION OF TRAUMATIC HEMATOPERITONEUM*

CASE REPORT

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THE striking similarity of the clinical picture of a case of hematohernia resulting from slow intraperitoneal hemorrhage to one of strangulated inguinal hernia with intestinal obstruction is illustrated in this case:

CASE REPORT

A white male, age 43, was working on a large crane at one of the automotive factories in Detroit on December 7, 1939. At 8:45 a.m., the patient's chest was accidentally caught between the shaft and drum of the crane when a mistake in signals occurred. Severely injured, he was immediately taken to the factory hospital for emergency treatment and observation. At 5 p.m. he was transferred to the Henry Ford Hospital. At this time the patient complained of severe pain in the chest and epigastrium which was aggravated by body movements, respirations or cough. There was no history of hemoptysis or shock.

Examination showed a well developed and well nourished adult, white male who was in marked pain. T.P.R. 100-116-30. Respirations were shallow and accompanied by expressions of pain. The motion of the right thorax was definitely limited. A grating noise was audible over the fourth left rib at the costochondral junction. Marked point tenderness was present over the right third, fourth, fifth and sixth ribs in the anterior axillary line and over the left fourth rib at the costochondral junction. Percussion and auscultation of the lungs were essentially negative. The heart sounds were rapid but of good quality. The blood pressure was 120/80. There was muscle spasm and tenderness present in the epigastric region but no rebound tenderness. Normal liver dullness was elicited.

Laboratory data: Urinalysis was essentially negative; white blood count was 30,000 with 96 per cent polymorphonuclear leucocytes.

Roentgen examination of the abdomen and electrocardiographic examination of the heart were negative shortly after his admission.

Chest stereos showed fractures of the second, third and fourth ribs in the right axillary line.

A diagnosis of multiple fractured ribs and possible intra-abdominal injury was made.

Course in Hospital. Since the patient had not been in shock at any time, and since no rupture of a hollow viscus could be demonstrated, conservative treatment with constant observation was carried out. On the second day the patient developed a bronchopneumonia, the pneumococcus type xxi, being demonstrated in the sputum. Sulfapyradine therapy was started. On the fourth day considerable abdominal distention was present. The red blood count had progressively fallen to 2,400,-000. It was believed that the patient had been slowly bleeding either into the peritoneal cavity or retroperitoneal tissue, although at no time did his systolic blood pressure fall below 100 mg. of mercury after his admission to the hospital.

Under continued expectant treatment including repeated blood transfusions, hot abdominal stupes, continuous gastric suction, continuous oxygen therapy and sulfapyradine administration, the patient rapidly improved. On the seventh day his temperature had fallen to normal, his abdominal distention had disappeared and the patient looked and felt well for the following four days. Suddenly, during the night of the eleventh day, the patient became worse. He complained of cramping abdominal pain, distention, nausea, repeated vomiting and a painful, irreducible mass in the left inguinal region. T.P.R. was 102°-112-40; leucocyte count was 20,000 with 90 per cent polymorphonuclear leucocytes. Roent-

gen examination of the abdomen showed dilated loops of the small intestine, indicating the presence of small bowel obstruction. Blood chlorides were 454 mg. per cent and N.P.N. 41.6 mg. per cent.

The presence of intestinal obstruction and the irreducible, tense, tender inguinal mass necessitated the diagnosis of strangulated left inguinal hernia.

Emergency operation was performed under local anesthesia, and a complete left indirect inguinal hernial sac was found. The wall of the sac was tense, thickened and blood stained. The lumen contained old dark liquid blood but no loops of bowel or omentum. The neck of the sac was very narrow and closed by recent fibrinous adhesions and edema. A Bassini type of repair was done including a high ligation of the neck of the sac.

The postoperative course was very stormy, being complicated by high fever, abdominal distention, acute left secondary parotitis and bronchopneumonia. The parotitis subsided under large doses of Lugol's solution, according to the method of Leithauser and Cantor.[1] The pneumonia disappeared after sulfapyradine administration. His condition had improved sufficiently for him to be discharged from the hospital on 1-17-40.

DISCUSSION

In Maingot's "Postgraduate Surgery"[2] is found the following quotation: "Its diagnosis (strangulated hernia) is easier than any other abdominal emergency. A tense, tender, and irreducible swelling at a hernial orifice associated with the general symptoms of obstruction, presents a clinical picture capable of only one interpretation."

In the case presented here, the clinical picture is identical yet no strangulation was present.

In retrospect, this case appears to be one of multiple fractured ribs and slow, continued intraperitoneal hemorrhage secondary to the crushing injury to the lower chest and epigastrium. It was complicated first by pneumonia and intestinal ileus, both of which disappeared under treatment. Later, after continued coughing by the patient, a left inguinal hernial sac became tense and filled with old blood. This was associated with the reappearance of abdominal distention and signs of intestinal obstruction.

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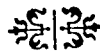
DUODENAL STASIS COMPLICATING GASTROJEJUNAL ULCER

REPORT OF A CASE

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GASTROJEJUNAL ulceration following gastroenterostomy is a surgical rather than a medical problem. Early surgical intervention is indicated because of the serious complications of gastrojejunal ulcer which may follow undue procrastination. There are five chief complications of gastrojejunal ulcer: (1) recurring hemorrhage; (2) acute perforation; (3) subacute perforation; (4) gastrojejunocolic fistula; and (5) duodenal stasis. Duodenal stasis as a complication has not been emphasized in the literature although it occurs in about 10 per cent of gastrojejunal ulcers.[1] It is particularly common in gastrojejunal ulcers of long standing. Wilkie[3] says that the tendency to thickening and fibrosis in the region of the stoma leads on the one hand to a gradual narrowing and in some cases to a potential, if not an actual, occlusion of the gastro-enterostomy opening, and on the other hand, to an inflammatory induration of the root of the mesentery which interferes with the efflux from the duodenum. Wilkie further points out that failure to overcome duodenal stasis leads to persistence of discomfort and may, if the gastroenterostomy has been simply removed, lead to a recrudescence of the duodenal ulcer.

We are reporting a case of gastrojejunal ulcer of long standing complicated by marked duodenal stasis and perforation which was successfully treated surgically.

CASE REPORT

A male, aged 57, had had a gastroenterostomy eighteen years previously for duodenal ulcer. After the gastroenterostomy he felt better, but continued to have some gastric distress. About five years previous, he began to have pain in the lower abdomen and back, accompanied on several occasions by vomiting. Ten months before the pain had become more severe in the stomach and lower abdomen and tarry stools were noted. Several months of improvement followed, but four days previous to his admission to the hospital he had severe burning pain in the abdomen, which was relieved by inducing vomiting. No diarrhea or tarry stools were noted at this time. The patient reported that he had lost about 10 pounds in weight during the previous two weeks.

Roentgenograms taken after a barium meal showed the duodenum so dilated that it was larger than the stomach. However, the obstruction was not complete as some of the barium passed the site of the gastroenterostomy stoma. (Fig. 1.)

The patient was prepared for operation by keeping the stomach empty with continuous gastric suction for three days. During this time the plasma chlorides, which were low, were brought up to normal by the intravenous administration of glucose and saline. A blood transfusion was given to overcome the serum protein deficiency and injections of thiamin chloride to supply vitamin B₁. At the operation it was found that the omentum was adherent to a perforation of the gastrojejunal ulcer which measured about 1 cm. in diameter. The colon was involved in the inflammatory mass and was densely adherent to the anastomosis, but the wall of the colon was not perforated. The colon was freed by sharp dissection and the gastroenterostomy taken down. The ulcerated portion of the jejunum was resected and its continuity reëstablished by end-to-end anastomosis. The ulcerated portion of the stomach was removed and the stomach closed. There was no evidence of ulceration at the pylorus or first portion of the duodenum and there did not seem to be any constriction at the pylorus. A jejunostomy was made distal to the resected portion of the jejunum and the incision closed without drainage.

During the postoperative period the patient's stomach and duodenum were kept empty by means of continuous gastric suction. Fluids and nourishing formulae were administered

through the jejunostomy tube and vitamin B₁ supplied by daily injections of thiamin chloride. Two blood transfusions were given during the postoperative period. After the first four

dividing the operation into stages. The ulcer had not perforated through the entire wall of the colon, but it was extensively involved in the inflammatory process.

FIG. 1. Roentgenogram of the stomach and duodenum before operation. Note the enormous dilatation of the duodenum.

FIG. 2. Roentgenogram of the stomach and duodenum two months after operation. Note the duodenum has returned to normal size and empties normally.

days the continuous gastric suction was discontinued but the stomach was aspirated twice daily. The gastric retention decreased gradually so that at the end of three weeks it was possible to discontinue the aspirations and start feeding the patient by mouth. The jejunostomy tube was left in for two months as a safety valve. It was removed after roentgenograms showed that the duodenum had returned to normal size and function. (Fig. 2.)

The patient's condition continued to be entirely satisfactory. He gained 41 pounds in weight in the six months following operation, eating an ample but careful diet, and reporting no distress whatsoever.

DISCUSSION

This case illustrates some of the complications which may occur in a gastrojejunal ulcer of long standing. There was perforation of the ulcer, involvement of the colon and marked duodenal stasis. All of these complications add greatly to the surgical risk of gastrojejunal ulcer. In most cases it is best to limit the first operation to closure of the perforation, but in this case the marked duodenal stasis precluded

The question of the best way to handle the very marked duodenal stasis was a difficult one. Wilkie has advised duodeno-jejunostomy in many of these cases to drain the duodenum. In this case the duodenum returned to normal size and function after relief of the obstruction. Ravdin and his associates have recently shown the importance of vitamin B₁ in maintaining gastrointestinal tone and motility. It is possible that the administration of adequate doses of thiamin chloride may have been a factor in causing the size and function of the duodenum to return to normal. The importance of the jejunostomy in maintaining the patient's fluids and nutrition while the stomach was being kept empty is also demonstrated in this case.

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DELAYED BREECH EXTRACTION*

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AT some time in every obstetric experience there arises the problem of the refractile and insuperable Bandl's ring. The various means available for obtaining relaxation of the ring are well known and possess one common characteristic: that none is to be absolutely relied upon. The following case report presents a method of management which we have heretofore never employed but which was forced upon us by the exigency of the situation.

Mrs. C. T., age 34, a colored housewife, was admitted to the obstetrical service of Harlem Hospital May 29, 1939 at 1:30 A.M. She had had four previous pregnancies all of which terminated without difficulty. Previous prenatal periods had been uneventful and the Wassermann test was negative. Her largest baby weighed 7 pounds at birth. Her pelvis was classified as generally contracted, the true conjugate measuring 9.5 cm.

Throughout pregnancy the blood pressure was well within normal limits and repeated urinalyses were negative. It was estimated, however, that the baby would be larger than the others had been.

Examination on admission was entirely negative save for a slight pretibial odema, which, in the absence of elevated blood pressure and urinary pathology, was considered as due to pressure on the pelvic vessels. The fundus, measured by the method of MacDonald, was 42 cm. A vertex presented as right occiput posterior. The fetal heart was audible in the right lower quadrant of the abdomen. Irregular contractions were occurring at the time of admission, but the patient fell into active labor within one hour. On rectal examination the cervix was found to be 2 cm. dilated, the membranes were intact and by the Hillis impression, the vertex could be brought to the spines.

Labor proceeded without event until 10:30 A.M. when the cervix was completely dilated and retracted over the presenting vertex. Despite powerful voluntary efforts, no progress was made, even after spontaneous rupture of the membranes at 11:15 A.M. By noon, the patient appeared exhausted; the pulse was running at 110 beats per minute, voluntary efforts were diminishing and the vertex was at station minus 1 with the occiput still in the right posterior quadrant. Operative delivery was decided upon.

Under deep anesthesia effected by ether by the open cone method, Kielland forceps were applied and rotation of the head was attempted without success. Traction to bring the head to a more favorable level for rotation failed. The fetal heart was audible and the forceps were removed. Version and extraction appeared to be the procedure of choice.

The head was firmly fixed in the superior strait and considerable difficulty was encountered in attempting to displace it. When displacement was finally accomplished, the operator encountered a firm contraction ring through which it was impossible to pass the closed fist. Anesthesia was deepened and, with some difficulty, version was completed. After a pause, extraction was attempted and found utterly impossible. Three 15 minim doses of adrenalin were administered in an attempt to overcome the contraction ring, but even these coupled with the profound anesthesia had no noticeable effect. Exploration revealed that the ring had moulded about the fetal pelvis and so firm was its grasp that even almost violent traction failed to achieve progress. At this time, the fetal heart was not heard and in the face of this complete failure, the anesthesia was discontinued. Exactly fifty minutes after anes-

thesia was first started, attempts to complete delivery were discontinued, the patient was permitted to recover and morphine was given hypodermically. An infusion of 1000 cc. of 5 per cent glucose was started.

The general condition of the patient was fair. The pulse was 120, there was no evidence of shock and there was no bleeding. The contraction ring was now both visible and palpable. The patient was kept on the delivery table and the uterus was constantly observed for signs of relaxation. Under the influence of the morphine, the patient dozed and after the infusion was completed, the pulse had dropped to 102. From 1:00 p.m. to a few minutes after 4:00 p.m. observation continued. It was then believed that the ring was relaxing. At 4:15 anesthesia was begun and under its influence the visible ring disappeared. Palpation showed a soft, pliant uterus and to our surprise, the fetal heart was easily audible, regular in rate and rhythm.

Breech extraction was begun and at 4:50 p.m. a 10 pound 1 ounce baby was easily delivered after application of the Piper forceps to the aftercoming head. The baby was resuscitated with ease. Brisk hemorrhage occurred immediately after delivery; the placenta was removed manually and the uterus thoroughly packed with iodoform gauze. Oxytocics were administered. After reacting from the second anesthesia, the patient was in excellent general condition.

The post partum course of mother and infant was uneventful. Packing was removed on the third day and the patient was discharged on the fourteenth day. The post partum check-up six weeks after delivery revealed good general condition, the presence of a moderate cystorectocele, a firm, healed cervix and a well involuted uterus in good position. The breasts were functioning and the infant was thriving on breast milk.

SUMMARY

We have presented a case in which breech extraction could be accomplished only after four hours of observation following version. It serves to indicate that adrenalin is an unreliable weapon in attacking contraction rings and that morphine, fluids and patience are obstetrical instruments of matchless value and incomparable importance.
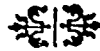
WILLIAM OF SALICETO—THE SCHOOL OF BOLOGNA

INCUNABULA MEDICA V

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SAN FRANCISCO, CALIFORNIA

THE medical school and faculty at Bologna were to pass through the same successive stages of growth and decline as that of Salerno, Alexandria and other centers preceding it. The formula in this progress was the same: First a period of initial gathering together of students usually under the influence of some individual who stood head and shoulders above his fellows in technical ability or intellectual knowledge. Gradually from all over the world, the faculty would be enlarged, progress and contribution would be exceptional and worthy and a middle period of the flowering of medical knowledge would follow; finally, a third and last stage of waning influence and a shifting of the scientific and intellectual locale to some other part of Europe. Such had been the history of each medical center and Bologna was to be no exception. The intellectual torch was destined to shift shortly from Bologna to Paris and the University there.

During the period of its greatest activity Bologna contributed many illustrious names other than that of Hugo of Lucca to the history of medicine. These names are prominent because they represent men who did outstanding work in their day. Among these names we find that of William of Saliceto, a brilliant surgeon, considered the greatest of his time. A pupil of his, Lanfranco, was to figure prominently in the actual transition of the center of surgical knowledge and activity from Italy into France.

Guglielmo de Placentinus Saliceto, or William of Saliceto, so named because he was born (in 1210) in Saliceto, a small town near Piacenza and also near Bologna, studied medicine at the medical school of Bologna and received his degree there. Following the completion of his studies he obtained the post of town physician in Verona but remained there only a short time as he was called to the faculty of his alma mater.

While engaged in this task of teaching he contributed much to medical literature. His major work was a "Cyrurgia" consisting of five separate books or parts. Present day terminology would call these chapters. The first book is a rather miscellaneous affair commenting on a variety of illnesses and their treatment, with here and there an original observation or comment of his own. In this book he described quite accurately and completely the symptoms and objective findings we associate today with Bright's disease, and called it "Mal de Renis" or disease of the kidneys. In the thirty-eighth chapter of this book he starts with, "Signa lapidis in Renibus sunt," "the signs of the stone in the kidney are," and proceeds to give as accurate and detailed a description as could be found anywhere today.

The second book deals mainly with contusions in various parts of the body, particularly contusions of the head, and an attempt is made to differentiate between the symptoms encountered in simple concussion and those in cases of fracture.

The third book is devoted to fractures and dislocations with a description of various ingenious devices used in their reduc-

make as a busy operating surgeon. Many the patient whose operation was prolonged in those times that the surgeon might take

FIG. 1. Illustration of instruments used and devised by William of Saliceto.

tion. Many of these were of his own invention.

Book Four is more interesting than any of the others as it represents the first attempt to write a topographical anatomy. Its weakness lies in the fact that it was not based upon human dissection, but only upon those observations he was able to

advantage of the opportunity to orient himself better anatomically with the area in view!

The fifth book was more or less a materia medica, listing drugs, plants and their uses medicinally. The problem of migraine was apparently as perplexing in his day as in ours if one can judge by the number of

prescriptions he lists for it—seventeen all told. From his dialogue here he made the differential diagnosis of tertian and quartan overuse of the cautery, which was a prominent custom then and fostered mainly by Arabian authorities. Here credit must be

FIG. 2. The causes, symptoms and treatment of hemorrhoids from Saliceto's "Chirurgia."

malaria and states that in rare cases it was possible for the patient to have both types simultaneously and that when this occurred there was no definite timing of the occurrence of chills—not bad diagnostic acumen for the early part of the thirteenth century. This book closes with a tirade against

given to the independent mind and spirit of the man. The influence of Constantin and the School of Salerno was felt, even after many years, in the teachings and practice of the School of Bologna. The School of Salerno had been largely Arabian in its own teaching and practice, and had followed

very closely the written words of Rhazes, Avicenna and Avenzoar.

Although William was quite familiar with Arabian medicine, he was not entirely

plea for those who considered themselves surgeons to adopt his recommendation, and blasts those who dared not change because of their limited abilities.

LANFRANCI   **MAIORIS**   223

[Facsimile of early printed page in Latin, with anatomical woodcut illustration of a stomach.]

Fig. 3. Description of stomach disorders written by his pupil, Lan Franco, but essentially the work of Saliceto.

converted to some of its practices, specifically in its use of the cautery. All around him he saw men cauterizing everything because it was the easy thing to do. He urged that the skillful use of the scalpel was a much better procedure and in this fifth book of his, "Surgery," he closes with a

This "Cyrurgia" proved to be very popular. There are many incunabula editions of it. The first was printed in the town of Piacenza, in 1476, almost two hundred years after his death; those copies existing prior to that time were only in written manuscript form. A few complete manu-

scripts were available to students in Italy and in France. Translations from the Latin into Italian of parts of the book were available in the medical centers of Bologna, Padua, Milan and Salerno.

Another incunabula edition was printed in Venice in 1490 by the famous Aldus Press, and another edition which just misses the incunabula period was printed by the same press in 1502.

In the interim many translations had been made of the original, one in French, one in English and two partial translations into Hebrew. One of the French translations was printed in Lyons in 1492 and is included in the incunabula group.

He completed another manuscript entitled "Summa Conservationis et Curationis." Like the "Cyrurgia," it also consisted of five parts. Part One was devoted to special pathology, "A Capite Ad Calcem," from "head to heel." Part Two consists of thirty eight chapters devoted to fevers, their diagnosis and treatment. Part Three deals with diseases of the skin and contains several chapters on the use of cosmetics, or the "decorative arts" as it was called. Part Four is a toxicology, describing the toxic symptoms of many drugs and the antidote indicated for each.

As one searches in the old literature of this period, he cannot but be struck with the overemphasis placed upon toxicology and the myriad of "Antidotarium" manuscripts which were written then. One hesitates to assume that so many people used medical means to commit suicide, and one is left to wonder if the art of poisoning enemies was not developed to such a high and efficient degree that extensive knowledge along these lines was called for on the part of the physician. Necessity made familiarity with these many lists of antidotes essential. Almost every physician who had much experience in this sort of practice found incumbent upon himself to publish a list of his own antidotes, otherwise consider himself "declasse."

Part Five of the "Summa" is an "Art of Practicing Medicine" or could be titled,

"The Proper Bedside Manner." It consists of a description of the manner in which a history should be taken and the proper diagnostic enquiries which should be made in various types of cases in order to clarify the diagnosis. Interns disgruntled with the prosaic task of taking an extensive history can take either heart or head in the fact that this same procedure has been going on for hundreds of years, as witness a man in the middle of the thirteenth century insisting on a complete detailed history of each of his cases.

In his "Cyrurgia" many authorities claim to find reference to human dissections, and that some of his anatomical descriptions are based upon knowledge and experience greater than that which could be obtained by means of exercising the surgical art per se.

It is well recognized that in addition to being a flourishing medical center during this century, Bologna was at the same time the greatest center of legal teaching in the world. It would not be surprising in view of this if some of the law faculty recognizing the value of postmortem evidence, would not take some means of furthering the possibilities of obtaining such evidence.

The church did not formally prohibit human dissection but did specifically forbid the cutting up of corpses and boiling them in order to separate the bones from the flesh. This strange practice had come about during the Crusades. Many who died during these pilgrimages wished that their bones be repatriated in their own parish at home. As the problem of transportation was an all important factor, and interpretation was made, all too literally, that it was the bones which were to be reburied and not the whole body, resulting in the above practice. Some one some day should write the story of the Crusades from an iconoclastic viewpoint and tear away the beautiful coating of varnish with which they have been ecclesiastically endowed.

It is known that William had as a patient a Franciscan monk from Parma who died suddenly in the street at Bologna. The

law faculty before certifying to the death, insisted that some type of medical postmortem examination be made to determine more accurately the cause of death. William, as the leading medical authority of the city was chosen to make this examination. It is recorded that as in his own mind the cause of death must be in the heart, he opened only the chest cavity and removed the heart for further study.

If it is accepted that his anatomical drawings and descriptions are based upon human dissection, then his anatomy is the first such work. A glance at some of his anatomical plates would indicate that they are far inferior to those of da Vinci and hardly to be compared with those of the great anatomists who were to come later.

In the later years of his life William took first as a pupil then as an associate, one Lanfranco of Milan, who was to prove worthy of his choice, as through him, William's work and teachings lived on and were to influence another school or center of learning in another part of the world.

This Lanfranco was to take to France that of medicine and surgery which was Italian, and to serve as the torch bearer in the transition of the seat of medical learning from Bologna to Paris. The influence of this great center was to wane gradually and that of Paris to ascend rapidly. The scene once again moves westward, France to have its day, Paris the locale.

William died in 1280 and was buried at Piacenza. In recent years some of the authorities in the field of medical history have raised the controversy that the books in surgery and medicine that have been attributed to him could not possibly have been of his authorship. Entirely too much stress is laid on the fact that printed works of his are exceedingly rare and possessed by only one or two of the great collections in the world. Lists of the works printed during the incunabula period by the Aldine and Giunte presses in Venice fail to mention any manuscript of William's as being used for publication. All of this seems beside the point when one finds hidden away in the haphazard bindings of several works by different authors much material that it is Saliceto's and Lanfranco's.
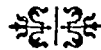
Selected Book Reviews

WILLIAMS OBSTETRICS*

A TEXTBOOK FOR THE USE OF STUDENTS AND PRACTITIONERS
By HENRICUS J. STANDER, M.D., F.A.C.S.

J WHITRIDGE WILLIAMS was a gentleman of the old school and a great force for good in American Obstetrics. His textbook went into many editions during his lifetime and thousands of medical students studied its pages. As a text it was outstanding because it was authoritative and its style was moulded along classical lines. About six years ago Dr. Stander, who had been Dr. Williams' associate at Johns Hopkins, and who for the past decade has been Professor of Obstetrics and Gynecology at Cornell University Medical College, undertook the revision of the "last edition of Dr. Williams' textbook, prepared by him in 1930." We are told Stander undertook this work with "some hesitation and a certain amount of misgiving," which we can believe. However, after publication the book was acclaimed by both practitioners and teachers in this country, Canada and abroad.

THE NEW EIGHTH EDITION

It is an old adage that one should not paint the lily, but in this particular case Stander repainted Williams and made an excellent job of it. And now we are offered an Eighth Edition. Stander says, "The book has been almost completely rewritten, with the result that little of the original text remains unaltered. Old chapters have been rearranged and changed, and three new chapters added: 'Diseases and abnormalities of the newly born child,' 'Classification of abnormal and contracted pelves,' and 'Sudden death and maternal mortality.'" Some sections (as that on embryology) have been shortened, while others have been rewritten and new classifications offered.

* Eighth Edition. New York, 1941. D. Appleton-Century Company, Inc.

The author tells us that while different teachings and controversial theories are presented and brought up to date, the reader is left in no doubt as to the author's own views. Most of the text dealing with historical or theoretical considerations appears in small type.
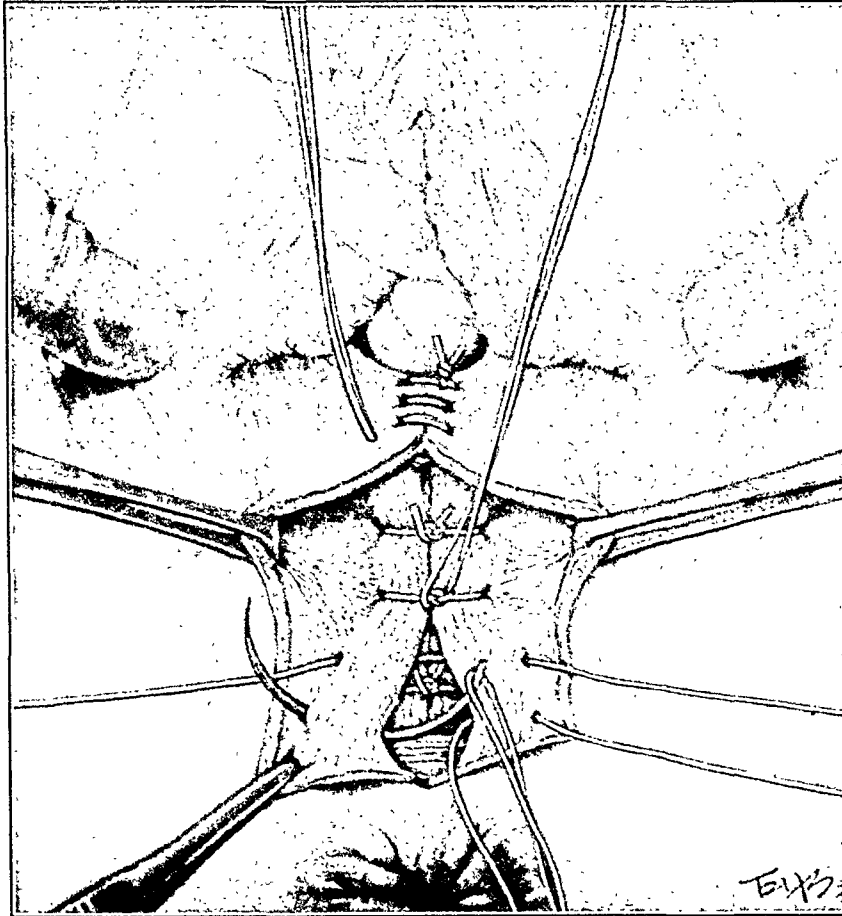
Fig. 1. Repair of Median Episiotomy. Step 3. A second layer of interrupted sutures through the fascia of Colles is sometimes necessary to ensure proper approximation and release of tension on the deeper layer of sutures. (Figure 272, p. 435, in Stander-Williams' Obstetrics, D. Appleton-Century Company, Inc.)

SANE, MODERN, CONSERVATIVE

Nothing could be gained in attempting a critical review of the text. Suffice it to remark that the work is *sane, modern, conservative*, and offers the student everything desired in a textbook; and it is a work the practicing physician will find more than adequate when he refers to it at the time he is faced with a problem.

The illustrations (over seven hundred) are excellent and a great aid to the reader. The Literature appears at the end of each chapter and there is an ample Index.

In his day Williams was the author of a great textbook on Obstetrics. Stander then made a revision and the result is a book called Williams Obstetrics which has little of the original Williams in it. For the most part it is a new work from Stander's pen, and as such
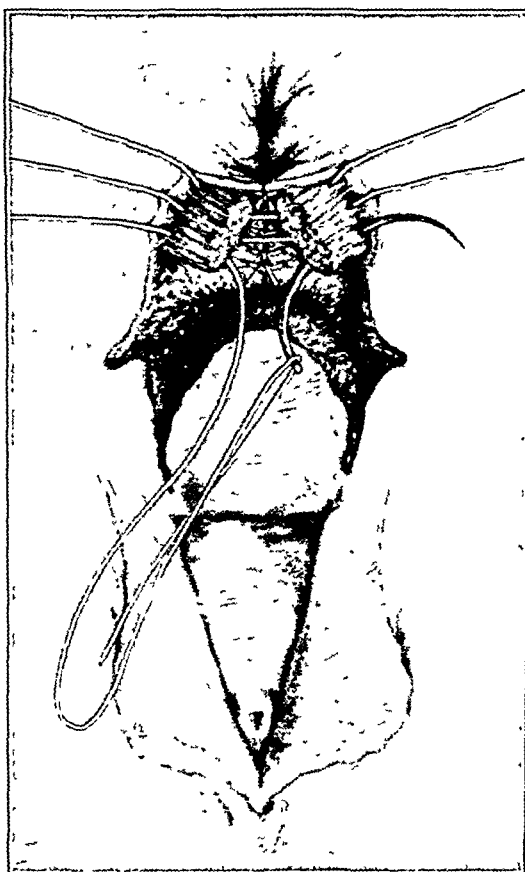
FIG. 2. Repair of Complete Perineal Tear. The rectal mucosa has been repaired with interrupted, fine chromic catgut sutures. The torn ends of the sphincter ani are then approximated with two or three interrupted chromic catgut sutures, after which the wound is repaired along the same lines as outlined in a second degree tear or an episiotomy. (Figure 276, p. 439, in Stander-Williams' Obstetrics, D. Appleton-Century Company, Inc.)

we have another great book on the subject. Every physician, practitioner or specialist who does obstetrics should have this book in his library. Medical students should read and study two or more texts and college teachers might well recommend this work as a "must."

A HISTORY OF MEDICINE*

TRANSLATED FROM THE ITALIAN AND EDITED
BY E. B. KRUMBHAAR, M.D., PH.D.

BY ARTURO CASTIGLIONI, M.D.

WHEN this book arrived at our office we looked through it, read parts here and there and then turned back to the first page and started to read the book as a whole. We read no other book until we had finished a thousand pages of text— the complete work. And we enjoyed every paragraph and learned a great deal, more than we will ever retain. We recite these facts to impress upon the reader that it is no dry, statistical, encyclopedic work to be used only as a reference but that it is a history of medicine that reads like a lively novel. On the jacket is printed: "This is a detailed survey of the science and art of medicine from prehistoric times down to the year 1940 . . . Its rich information is presented under three aspects: that of ideas, the evolution of medical thought; that of important medical events, discoveries, inventions and achievements; and that of the more prominent medical personages." The whole is presented against the background of the development of art, of social and political life.

THE AUTHOR AND TRANSLATOR

The first Italian edition was published in 1927, when the author was teaching the history of medicine at the University of Padua. At present he is Research Associate in the History of Medicine at Yale University. Dr. E. B. Krumbhaar, Professor of Pathology at the University of Pennsylvania, translated this work from the original Italian and has performed an expert task. We are told that he has adapted it throughout for American readers in collaboration with the author, and has greatly expanded the sections on British and American medicine especially in modern times.

THE PUBLISHER

Typographically, the publisher has done a beautiful job. The illustrations, 443 in number, are well made. There is an appendix, a

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bibliography and an index. The reader will find the print easy on the eyes, and if he knows the intricacies of the trade he will recognize that the work is a fine example of the bookmaker's art. The publisher is to be congratulated for offering this wonderful book to both the lay and professional public.

NEED FOR HISTORICAL MEDICINE

Little time is given to the history of medicine in most American medical schools. Some medical colleges devote no hours at all to this subject and many only six or eight lectures. We believe this to be a mistake. No man is efficient in his profession until he knows a great deal about the history of his calling. Should any who teach medical students read this, we hint that they might read Dr. Castiglioni's book themselves, and then suggest to their junior and senior students that they get it and read a chapter every night or every week.

Lay people often desire to give some inexpensive gift to their physician, or a physician often wishes to give a fellow practitioner a gift. Here is the ideal and perfect gift. We are glad this splendid history of medicine has been published. It is sure to stand alone on a high peak for a long, long time.

SPECIAL MONOGRAPH

CANCER OF THE TONSIL

BY

HAYES MARTIN, M.D.

Attending Surgeon, Memorial Hospital

AND

EVERETT L. SUGARBAKER, M.D.

Rockerfeller Fellow in Cancer Research, Memorial Hospital

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CANCER OF THE TONSIL

HAYES MARTIN, M.D.

Attending Surgeon, Memorial Hospital

AND

EVERETT L. SUGARBAKER, M.D.

Rockefeller Fellow in Cancer Research, Memorial Hospital

NEW YORK, NEW YORK

CANCER of the tonsil represents about the average of the several anatomic forms of malignant growths of the pharynx from the standpoints of frequency and malignancy. Tonsillar tumors are of particular interest since they comprise a well defined anatomic and histologic group in a region which is readily accessible to either surgery or radiation, so that the possibilities of these two methods in this area may be fully explored and compared.

The present report is based upon 157 unselected consecutive cases of cancer of the tonsil, *including all patients in all stages of the disease* who applied to the Memorial Hospital during the years 1931 to 1935, inclusive. Duffy[15] has reported a preceding series (1920 to 1930) from our clinic.

Definition. In the present report the term, "cancer of the tonsil," designates those growths which arise in the palatine tonsil itself, at its periphery in the tonsillar fossa, in the tonsillar pillars (glossopalatine arch, pharyngopalatine arch), or in the plica triangularis. The term must not be confused with "cancer of the nasopharynx" (pharyngeal tonsil or adenoid) or "cancer of the lingual tonsil" (base of the tongue).

Anatomy of the Tonsil. The palatine tonsils are two large ovoid masses of lymph tissue which are embedded in the side walls of the oral part of the pharynx between the glossopalatine and pharyngopalatine arches. The latter two structures and the adjacent edge of the tongue outline a triangular area with its apex above, which is known as the tonsillar fossa. For purposes of classification, the tonsil should be considered a pharyngeal structure, the line of demarcation between the oral cavity and the pharynx being the free edge of the soft palate and the anterior tonsillar pillar. The tonsil occupies the inferior position in this triangle, and above it near the

apex is the fossa supratonsillaris. From the lower margin of the anterior tonsillar pillar, a fold of mucous membrane, called the plica triangularis, passes backward between the tonsil and the edge of the tongue.
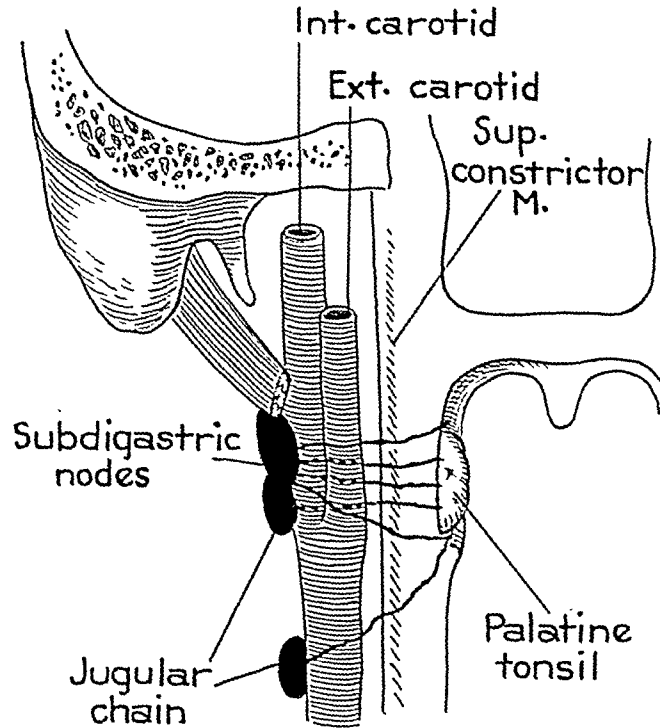
Fig. 1. *The lymph drainage of the palatine tonsil.* From the palatine tonsil the lymph vessels pass directly outward to the subdigastric lymph nodes of the jugular chain which are involved first in practically all cases of metastasis from the tonsil.

The tonsils themselves consist of masses of lymphoid follicles with a delicate connective tissue reticulum. Mesially the surface is covered by a thin layer of mucous membrane and is very irregular because of deep crypts formed by infolding of the epithelium. On the lateral surface the lymph tissue is invested with a rather firm connective tissue capsule which lies directly on the superior constrictor of the pharynx.

The Lymphatic Drainage of the Palatine Tonsil. The collecting trunks of the palatine tonsils are a part of a network which drains the entire pharynx. (Fig. 1.) They perforate the capsule of the tonsil and the superior constrictor, passing successively behind the styloglossus, the stylohyoid and the posterior belly of the digastric muscles to reach the external carotid artery. Most of the trunks then

[2]

pass behind the external carotid artery and end in the upper, deep cervical group of the jugular chain of lymph nodes. The principle node of this group lies just above the level of the bifurcation of the common carotid artery and is generally called the subdigastric or tonsillar node. From this node, the lymph drainage flows to the middle and thence to the inferior nodes of the jugular chain. It seems probable that there are only a few by-passes in this area, for metastases from the tonsil seldom appear first below the level of the subdigastric node.

<div align="center">ETIOLOGY</div>

General Incidence. From an analysis of the admission records of the Memorial Hospital, cancer of the tonsil comprises 8 per cent of all cancer of the upper respiratory and alimentary tracts and about 2 per cent of all human cancer. Of the structures of the pharynx, the tonsil (21 per cent) is second only to the extrinsic larynx (37 per cent) in frequency as the site of origin of malignant growths. These figures do not agree with those of Despons[13] who stated that the tonsil is the most frequent site of pharyngeal cancer. It is difficult to explain the findings of Schall[44] who reported that at the Collis B. Huntington Hospital cancer of the tonsil made up 9 per cent of 24,437 cases admitted for all forms of cancer.

Age and Sex. In the present series the average age was about fifty-seven years on admission and about 30 per cent of the patients were in the sixth decade. These figures are almost identical with most other anatomic forms of cancer of the upper respiratory and alimentary tracts in our clinic. The oldest patient was ninety-four, the youngest eleven. As one of us (M.)[29c] has previously reported, cancer in children is not uncommon in the nasopharyngeal tonsil but is apparently rare in the palatine tonsil.

In the present group, 86 per cent of the cases occurred in males and 14 per cent in females, a sex distribution which is almost identical with that of cancer of the tongue as observed in our clinic. There was no significant difference in the ages of males and females. All observers have reported a preponderance in males of cancer of the tonsil: Despons 92 per cent,[13] Nathanson 95 per cent,[38] Schall 89 per cent[44] and Mattick 91 per cent.[31]

Position of the Growth. Since the primary lesion is usually large when first examined, the exact site of origin within the tonsillar fossa cannot be determined in all cases. In over 90 per cent of the

<div align="center">[3]</div>

present series, the diameter was more than 2 cm. on admission, with an average of 4 cm. for the whole group. Less than 5 per cent of the tonsillar growths were 1 cm. in diameter or less and could be classified definitely as "early." The right side was involved primarily more often (60 per cent) than the left (40 per cent). Such an irregular distribution has been noted previously by Schall[44] who found 55 per cent on the right and Duffy[15] who found 57 per cent on the left. In our clinic, several forms of intraoral cancer have displayed similar inequalities in distribution; but since the disproportion always tends to be greater in the smaller series, we believe that it can be accounted for entirely by the laws of chance and, therefore, that it has no clinical significance.

Causative Factors. In growths of the palatine tonsil as in other forms of pharyngeal cancer, there appears to be no outstanding etiologic factor. Obviously the pharyngeal walls are not subject to the trauma of mastication nor to irritation from sharp or irregular teeth, which play definite rôles in the causation of cancer of the oral cavity itself. Hot foods and drink, which are held at least momentarily in the oral cavity, pass rapidly through the pharynx during the act of swallowing. Even when smoke is inhaled, the irritating effects of tobacco are confined largely to the oral cavity. In considering others possible etiologic factors, repeated attacks of acute or chronic tonsillitis would appear, theoretically, to be a likely form of chronic irritation in this area, but in our cases, as in the series reported by Berven,[2] the histories failed to reveal any unusual tendency in this regard. The diffuse stomatitis characteristically found in avitaminosis, syphilis, the Plummer-Vinson syndrome and the anemias, may extend to the pharynx and might also theoretically play a part in the etiology of tonsillar cancer, although we have no supporting statistical evidence. Leukoplakia, though occasionally found on the palate and anterior tonsillar pillars, has never in our experience occurred on the tonsils, but Citelli[9] has reported two cases of precancerous leukoplakia on the tonsils themselves.

In our series, about 70 per cent of the patients admitted the use of tobacco, usually smoking; but as we have previously pointed out in discussing other forms of intraoral cancer, at least this percentage of addiction is found in normal male adults of corresponding age. It seems to us that practically all statistical data offered in proof of a connection between smoking and intraoral cancer remain inconclusive. Nevertheless, in our clinic isolated cases

of cancer of the base of the tongue, the tonsil and the soft palate occur with sufficient frequency in heavy cigar smokers (ten to fifteen cigars daily) to lend strong support to the theory of a direct causal relation.

In our group, only 3 per cent of the Wassermann tests taken gave positive reactions, a figure which is identical with the findings of Schall.[44] This proportion is less than the average for the male population of corresponding age (6 per cent).[52] Since the number is not larger, it is undoubtedly only a coincidence that the percentage of syphilis in our series of tonsillar cancer is less than the general average. In any event, it is obvious that syphilis is not a factor in the etiology of cancer of the tonsil.

Poor dental and oral hygiene was observed in the majority of our patients; but since most of them were from the less fortunate economic group, such deficiencies are to be expected and, in the present series, were no more prevalent than among the skin cancer patients in our clinic.

SYMPTOMS, MORBID ANATOMY AND CLINICAL COURSE

In our series the average duration of symptoms (usually pain or "soreness" of the throat) before admission was seven months, as compared to fifteen months in cancer of the lip, ten months in cancer of the nasopharynx and five months in cancer of the tongue and of the floor of the mouth, respectively. Berven[2] reports an interval of four months between the beginning of symptoms and admission to the Radiumhemmet, while Nathanson[38] in his series reports an average delay of one year. In interpreting such figures it is essential to distinguish between the duration of the symptoms and the possible duration of the disease itself. In growths of such areas as the lip or anterior portion of the tongue, where the tactile sense is acute and the areas are under daily observation by the patient, the duration of the disease and the duration of the symptoms are more nearly equal. In the tonsillar area, on the other hand, there is little or no tactile sense and the discovery of the primary lesion by the patient must ordinarily await the development of pain, which may be long deferred. There is no way to determine how long the growth existed in these cases before pain first developed.

In contrast to growths of the oral cavity itself, the most common first complaint in our series of tonsillar cancer was local pain or sore throat (60 per cent). This finding might at first suggest that

this is an early symptom, except for the fact that the average diameter of the primary lesions was almost 4 cm. on admission. An ulcerated infected lesion of the tonsil of this size obviously must be painful, whether or not it produces any other subjective symptoms. Occasionally the growth in the tonsil is associated with such a degree of localized sepsis or cellulitis that the patient complains of pain radiating to the ear before admission, a symptom which is characteristic of advanced and uncontrolled stages of this disease.

After pain in the throat, the next most common symptom was the discovery of an enlarged lymph node in the upper deep cervical region (33 per cent in this series). In forty-four cases in which the patients complained only of enlarged cervical nodes, the primary lesions discovered first by the examining physician averaged 3.5 cm. in diameter. In one of these cases the metastatic node (proved by aspiration biopsy) was treated and permanently controlled by irradiation, and the patient was observed at monthly intervals for almost three years, with repeated examinations of the upper respiratory and alimentary tracts, before the primary lesion (about 5 mm. in diameter) was discovered in the tonsil and proved by biopsy.

The tactile sense of the pharynx is slight in comparison to that of the oral cavity itself. In less than 10 per cent of our cases did the patients state that they first became aware of a "lump in the throat," a disturbance in swallowing or a cough. The primary lesions in this small group were of about average size (3.5 cm.). In three cases of more bulky primary lesions (over 4 cm. in diameter) the first complaint was of earache, a well known form of radiating pain in inflammations of the throat. A few patients first noted such vague symptoms as cough, hoarseness, nosebleed, etc., too varied to be considered of real significance. It is probable that cancer of the tonsil must always reach a size of at least 1.5 to 2 cm. before sufficient infection occurs to cause pain or soreness or any other local symptom. In our series the patients with lesions less than 1.5 cm. in diameter sought medical advice only because of enlarged cervical nodes, and the primary lesions were discovered first by the examining physician.

An early tonsillar growth usually consists of a superficial granular ulcer either in the tonsil itself or in the groove between the tonsil and one of the pillars. (Fig. 2a and b.) The lesion may arise in a crypt and present only a small portion on the surface. As it enlarges the

tumor usually tends to fungate from and erode the surface of the tonsil, although occasionally, as in lymphosarcoma, it may invade deeply and produce a bulky submucous mass with little or no surface ulceration.
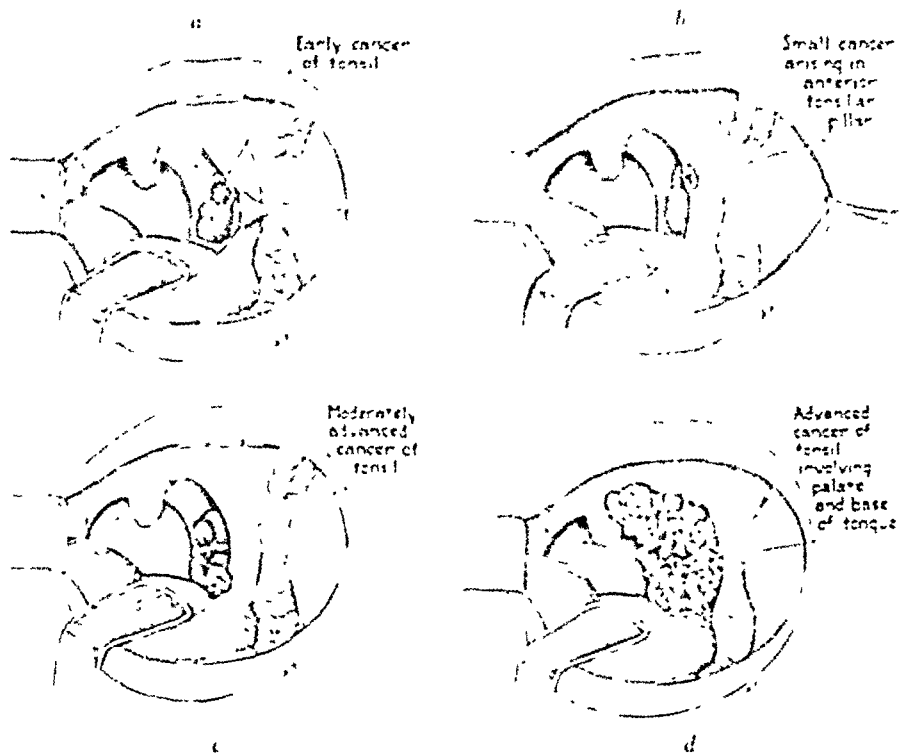
Fig. 2. Cancer of the tonsil begins either in the tonsil itself (a) or on one of the tonsillar pillars (b). Small lesions (a and b) or moderately advanced lesions (c) are the exception. In the average case the growth on admission has a diameter of about 4 cm. (d), so that the exact site of origin cannot be determined, and in these cases the growth has usually invaded the soft palate, both tonsillar pillars and the adjacent edge of the tongue.

By the time the lesion has reached a diameter of about 2 cm., beginning invasion of neighboring structures has taken place, usually in about the following order: the tonsillar pillars, the soft palate, the base of the tongue, the pharyngeal walls, the alveolar ridges and the mucosa of the cheek (Fig. 2d.) In its advanced stages the disease may involve the extrinsic larynx or the floor of the mouth and consist of a bulky, irregular, partly necrotic tumor, 5 to 6 cm. in diameter. At this stage intractable pain irradiating to the ear is a fairly constant symptom with trismus as well as dysphagia and pain on movement of the tongue. Hemorrhage due to erosion by the tumor

itself or as the result of radionecrosis is a frequent late symptom. Cervical metastasis is practically always a part of the clinical picture even in the earlier stages of the disease. If the growth is uncontrolled, death occurs from a combination of local causes: exhaustion from pain, sepsis, malnutrition, etc. In the present series, the average length of life in the unsuccessfully treated patients was about nineteen months. Other authors report survival periods varying from six to twenty-eight months: Berven,[2] Cristofordis,[8] Despons[13] and New.[39]

Metastases. In cancer of all parts of Waldeyer's tonsillar ring, metastases play an early and prominent rôle. In the present series about one-third of the patients noted enlarged cervical nodes as the first symptom. On admission clinically demonstrable cervical metastases were present in 76 per cent of the cases and subsequently developed in an additional 3 per cent.* These figures are almost identical with those of Mattick.[31] Other reports in the literature vary from 65 per cent to 92 per cent: Burnam,[4] Schall,[44] Costolow,[10] Levie[27] and New.[39] In thirty-six cases (25 per cent of the determinate group) there was no clinical evidence of metastasis on admission, and the disease was permanently controlled. In seventeen cases (11 per cent of the determinate cases) the patients died of uncontrolled cancer in the tonsil without the development of metastases after an average length of life of nineteen months.

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* The question might be raised as to the validity of the diagnosis of cervical metastasis in this series. At the present time, on the Head and Neck Service at the Memorial Hospital all cases of clinically demonstrable cervical metastases are subjected to aspiration biopsy as a matter of routine. In the earlier cases of the present series, not all clinically positive nodes were checked by this means, although of the whole group of 117 cases, in seventy-five (64 per cent) the diagnosis was confirmed by aspiration biopsy or histologic examination of excised nodes. In forty-two cases histologic confirmation was not obtained, and in this group only could there be any doubt. The possible margin of error can be estimated by a comparison of the average accuracy of clinical diagnosis in our clinic from date in another series.

Between the years 1930 and 1938, inclusive, 144 neck dissections were performed under the clinical diagnosis of metastatic cervical cancer (all neck dissections for primary cancer of the submaxillary glands, for carotid body tumors, and for benign diseases such as tuberculosis are excluded). In only twelve (8 per cent) of these did the histologic diagnosis fail to support the clinical diagnosis of metastatic carcinoma. Since in this operable group the disease was early, the chance or error would have been greater than in the average case of metastatic cancer from a primary lesion in the tonsil, which is usually far advanced and readily diagnosed clinically. If we concede a possible error of 8 per cent in the clinical diagnosis of forty-two unproved cases (or three cases), the total number with actual cervical metastases would still be 114, a variation from our reported figure of 117 which is too small to affect seriously the validity of our calculated figures.

The first node involved (in about 95 per cent of all cases) was the subdigastric, which lies in the upper deep cervical or jugular chain just above the bifurcation of the common carotid artery. Occasionally the first palpable metastatic node appeared in the submaxillary region and, more rarely, in the middle and lower parts of the deep cervical chain. Such variations are probably due to anomalies in the cervical lymph system, so that the main lymph stream is diverted past the upper deep cervical nodes through by-passes. After involvement of the subdigastric node, the disease tends to progress down the jugular chain to the clavicle and often into the posterior triangle of the neck along the accessory chain or sometimes into the submaxillary and submental lymph nodes.

When the main lymph drainage channels are blocked by radiation fibrosis or by surgical excision, subsequent lymph drainage must take place by the way of anastomoses, usually through the superficial lymphatics and finally across to the other side. Miliary metastases over large areas of the superficial lymphatics of the neck and cheeks probably always take place in this manner. We have observed this phenomenon in a number of instances of cancer of the oral cavity and pharynx. In one patient of the present series, a metastatic node in the upper deep cervical region appeared to regress completely with the primary lesion under radiation therapy. About three months later there was a recurrence in the tonsil which also responded to irradiation treatment. Several months later a subcutaneous metastasis appeared in the scalp near the occiput, followed shortly by another subcutaneous metastasis on the other side of the occiput with a later spread to the upper deep cervical nodes of the side opposite to that of the primary lesion and the original metastasis.

In nineteen cases (about 15 per cent of those which showed metastases) there were bilateral metastatic nodes on admission, and in one additional case bilateral involvement developed later. One of these patients, in whom the bilateral involvement was proved by aspiration biopsy, survived free of disease for more than five years.

It is a curious fact that dissemination below the clavicle to the viscera appears to occur only rarely. In the autopsy records of the Memorial Hospital there are twenty-nine cases of patients dead of tonsillar cancer with only three instances of visceral metastases (mediastinum, stomach, bones). Despons[13] has also called attention to the rarity of visceral metastases in cancer of the tonsil; and we believe the only reasonable explanation of this fact is that patients

with this form of cancer do not survive long enough, on the average, for the wide dissemination of the disease, although the histologic type of cancer in the tonsil would favor it.

TABLE 1
HISTOPATHOLOGY IN CANCER OF THE TONSIL

Epidermoid carcinoma.. 120
    Squamous cell, grade 1...................................... 4
    Squamous cell, grade 11..................................... 60
    Squamous cell, grade 111.................................... 20
    Squamous cell, grade 1v..................................... 1
    Squamous cell, ungraded..................................... 9
    Transitional cell, grade 11.................................. 3
    Transitional cell, grade 111................................ 9
    Transitional cell, grade 1v................................. 6
Lymphoepithelioma... 8
Lymphosarcoma... 22
Unclassified*... 15

                                                     157

    * This includes cases of patients referred for treatment of cervical metastatic cancer after the primary growth in the tonsil had been controlled.

HISTOPATHOLOGY*

A histologic classification of the growths in the series herein reported is given in Table 1. The epidermoid carcinomas (84 per cent) and the lymphosarcomas (16 per cent) present about the same relative distribution of these two tumors as in a series of nasopharyngeal

    * Dr. Fred Stewart, pathologist to the Memorial Hospital, has recently reviewed all histologic slides in this series and his analysis is as follows:

    Tonsillar cancer comprises several more or less well defined histologic entities. The terminology employed in the diagnosis of cancer of the tonsil at the Memorial Hospital is the following:

    The designation, "squamous carcinoma," serves to distinguish forms of epidermoid cancer in which keratinization and the occurrence of squamous pearls may be noted even though the cellularity and anaplasia be extremely marked. Degrees of anaplasia are indicated by the grading of the tumor.

    The term, "transitional cell carcinoma," is employed to designate a group of epidermoid cancers in which keratinization is absent or essentially absent. Such tumors tend to grow in plexiform character and exhibit varying diffuseness. They resemble the common epidermoid cancer of the uterine cervix which many European writers describe as basal cell epithelioma. The latter expression is not used in this connection at the Memorial Hospital because of possibilities of confusion with the common basal cell epithelioma of the skin. Transitional cell epithelioma may exhibit various degrees of cellularity and anaplasia which are likewise indicated by the grading assigned. Needless to say, squamous and transitional cell cancer may be imperfectly distinguished and there are borderline tumors where specific designation is impossible.

    The term, "lymphoepithelioma," introduced by Regaud[42] and later by Schmincke[45] has caused much difficulty. Laboratories are not in agreement as to what constitutes a

cancer recently studied, which is to be expected since both of these areas are parts of Waldeyer's tonsillar ring. Malignant salivary gland tumors are not uncommon in the palatine tonsil, but none occurred during the period covered by this report. Although the numbers in the separate histologic groups are too small to permit of definite conclusions from a statistical analysis of their respective clinical behaviors, we have attempted to extract certain pertinent data from the available material.

With regard to the primary lesion, the size on admission averaged 4.3 cm. in lymphoepithelioma as compared to 2.9 cm. in transitional cell carcinoma, although the average duration of symptoms was about one month longer (seven months) in transitional cell carcinoma. There was no appreciable difference in the average ages of the various histologic groups. Metastases were present on admission in 96 per cent of the transitional cell cases as compared to about 87 per cent in lymphoepithelioma and lymphosarcoma. There were bilateral

lymphoepithelioma. Thus Ewing[17] states that he examined tumors diagnosed as lymphoepithelioma by Lacassagne and found that they included types diagnosed by himself as transitional cell carcinoma and Schneiderian carcinoma. Tumors in our own collection received from Regaud with the diagnosis of lymphoepithelioma fail to correspond to the structure illustrated by Schmincke in his paper, yet do seem to fit the description furnished by his text, for Schmincke employs the term "syncytiales Karzinom," an apt designation both for the structure of certain primary tumors and for those metastatic deposits in nodes which some pathologists would regard as primary endothelioma of lymph nodes. Schmincke derived the lymphoepithelioma from the reticulum of the tonsil which he accepted as being of epithelial (entodermal) origin. If the reticulum of the tonsil is of epithelial origin, a supposition by no means generally admitted by morphologists, it has so far departed from its original epithelial morphology that it is not surprising that tumors originating from it should be separable with difficulty or not at all from reticulum cell lymphosarcoma. To make the distinction between reticulum cell sarcoma and lymphoepithelioma on the basis of the usual biopsy received in this hospital is almost impossible. Specimens are necessarily small, and since they are taken with forceps from soft tumors easily crushed, the intimate morphology is apt to suffer from distortion. In reviewing specimens formerly diagnosed by us as lymphoepithelioma, we have changed a number to lymphosarcoma and have retained a few, with some hesitancy, as certainly resembling the types described by Regaud and Schmincke. Thus the number of tonsillar lymphosarcomas in the Memorial Hospital records has been increased at the expense of tumors previously diagnosed as lymphoepithelioma. The field of diagnosis of these tonsillar and nasopharyngeal tumors is one of the most difficult in tumor pathology. Unfortunately the clinical course of the disease is by no means helpful in separating the types.

With the exception of one case of Kaposi's hemorrhagic sarcoma which occurred in the tonsil late in the course of generalized disease and one instance of probable granulation tissue sarcoma in a young male, the pathological laboratory at Memorial Hospital contains no instance of tonsillar sarcoma other than lymphosarcoma in one or another of its forms.

metastases in about 15 per cent of the lymphosarcoma and transitional cell groups as compared to 10 per cent in lymphoepithelioma and squamous carcinoma. The histologic grade of the tumor has considerable influence on the clinical course of the disease and especially on the tendency to metastasize, as shown in Chart 1.

Lymphoepithelioma appears to run a much more malignant course, the duration of life from the beginning of symptoms being twelve months as compared to seventeen months in transitional cell carcinoma.

DIAGNOSIS

Biopsy. Although a clinical diagnosis is not difficult in the average case of tonsillar cancer, a biopsy should always be made before treatment is instituted. It should be realized that treatment for cancer, whether by radiation or surgery, must be aggressive and therefore is always attended by definite risk, discomfort and expense. Without biopsy the clinical diagnosis will inevitably be erroneous in an occasional case. If the treatment is to be by radiation, not only should a tissue specimen be removed from the tonsil but an aspiration biopsy should be made for purposes of record to confirm the diagnosis of metastatic nodes.[29d] In the present series, the diagnosis of the primary lesion was confirmed histologically in all cases, and in the majority attempts were made to confirm the character of the enlarged cervical nodes. At the present time, aspiration biopsy of clinically positive metastatic nodes is routine in all cases of intraoral and pharyngeal cancer.

Delay in Diagnosis. On the basis of the average size (4 cm.) of the primary lesions in this series, it is obvious that cancer of the tonsil at the present time is not being diagnosed at an early stage. The most frequent first symptom of this disease, "sore throat," is not alarming to the average layman because it is also so characteristic of the more common acute and chronic tonsillitis and pharyngitis. The fiction of the benign character of cervical lymphadenopathy in the adult (usually metastatic cancer) is often supported by irresponsible medical opinion, and the patient is advised that he has "enlarged glands" and that he should apply hot compresses or massage the area with a well known proprietary ointment containing iodine. It is of interest to note that over fifty years ago Bland Sutton[49] called attention to the malignant character of most asymmetrically enlarged cervical lymph nodes in the adult and stated that he

believed practically all were secondary to undiscovered primary cancer in the mucous membranes of the oral cavity or pharynx. In our series the average interval from the first symptom to the first visit to a doctor was about two months, after which there was an average delay of about five months before the patient finally applied to our clinic with a tentative diagnosis of cancer. The medical profession is, therefore, clearly responsible for an average delay of five months in the diagnosis of this disease.

Chronic Tonsillitis. Since the patient with tonsillar cancer usually complains only of a sore throat when he first consults a doctor, the most common mistaken diagnosis is chronic tonsillitis, for which topical applications and gargles are usually recommended. In our series, tonsillectomy (an accepted method of treatment for chronic tonsillitis) had been performed in thirteen (9 per cent) of the cases before admission, and in nine of these there was gross and microscopic evidence of residual cancer in the pharynx. In only four of the cases had the excised tonsils been examined histologically. It is impossible to say whether these examinations were routine or whether the surgeon or the pathologist had requested the examination because cancer was suspected after gross examination, but it is obvious that most of the operations had been performed under a mistaken diagnosis of chronic tonsillitis. In any case, it is probably unavoidable that early cancer of the tonsil will occasionally be excised by a busy laryngologist, and for this reason the routine examination of all excised tonsils (as practised in many hospitals) is indicated.

A differential diagnosis between cancer and the chronically infected and scarred tonsil, following repeated attacks of acute tonsillitis with peritonsillar abscess, may be very difficult, especially in a patient who has histologically positive metastatic cervical cancer. Chronically infected tonsils usually present deep crypts which, on pressure, extrude inspissated pus with slight bleeding. Careful palpation of both tonsils is of value, with a comparison of the two for any differences in size and consistency. Specimens for histologic examination should be taken from localized indurated areas or from those which bleed on slight trauma. Systematic examinations of the entire upper respiratory and alimentary tracts should obviously also be made in such cases.

Syphilis. From an analysis of the present series, it is apparent that an erroneous diagnosis of syphilis is made less often in cancer of

the tonsil than in malignant growths of the tongue. In only three of our cases had antiluetic treatment been given—in one case for three years and in two cases for six weeks each. Gumma of the tonsil (which cannot be differentiated clinically from cancer) is exceptionally rare. In the records of our clinic going back to 1925, during which time over 450 cases of tonsillar cancer were treated, only one instance of gumma of the tonsil is recorded. The diagnosis was established by a biopsy of the tonsil, a positive Wassermann test and complete regression of the lesion in less than a month under antiluetic therapy.

Papilloma. This benign tumor occurs on the tonsil about as frequently as in any other area of similar size in the oral cavity or pharynx. Such growths have a warty papillary appearance, and show a greater tendency than cancer to fungate from the mucous surface. The diagnosis may be suspected from the clinical appearance, but final confirmation by histologic examination is required. The treatment is by narrow excision either by scalpel or endothermy. During the period covered by this report, one case of papilloma of the tonsil was seen at Memorial Hospital.

Rarely, patients with leukemia present markedly enlarged tonsils as well as generalized lymphadenopathy, but errors in diagnosis cannot occur with proper laboratory and physical examinations. Occasionally, patients with acute peritonsillar abscess, simple granuloma, actinomycosis and retention cysts are referred to a cancer clinic for a differential diagnosis. If biopsy is routine in the diagnosis of all suspected superficial cancer, these conditions will present no special problem.

GENERAL PRINCIPLES IN TREATMENT OF CANCER OF THE TONSIL

There is no structure of the pharynx more accessible to surgical removal than the tonsil. It performs no vital function and may be completely excised without great operative risk or postoperative shock. For benign diseases of the tonsil, tonsillectomy has long been one of the most successful of surgical operations, and from the theoretical standpoint alone early cancer of the tonsil should be amenable to surgical excision.

Despite these theoretical advantages, surgery offers little in the treatment of this disease, since the primary lesions are seldom small or sufficiently localized in the tonsillar fossa to be operable when first seen. In our series of 157 cases, the growths averaged about 4 cm. in diameter on admission. There were only two (about 1 per cent) in

which the primary lesion was 1 cm. or less, and in both of these metastases were already clinically demonstrable on admission, an indication in general of the inoperability of this disease. Simmons[45] found only one operable case among fifty-four patients with cancer of the tonsil. The literature from 1870 to 1910 contains a few reports on the surgical treatment of cancer of the tonsil, after which time, with the development of scientific radiation therapy, the surgical reports have steadily diminished in number as the suitability of radiation therapy in this disease has been demonstrated.

The earlier writers reported an operability of 40 to 60 per cent; but on weighing the evidence one must conclude that their surgical judgment in this regard was hardly sound since their operative mortality was about 30 per cent, and they appear to have obtained practically no cures. The simplest form of operation, tonsillectomy through the open mouth, was advised by Butlin.[5] Jacobson[20] recommended splitting of the cheek from the commissure back as in Jaeger's exposure for cancer of the tongue. In this cheek splitting operation and in all the more extensive procedures subsequently developed, most of the authors suggested preliminary tracheotomy as well as temporary ligation of the common carotid artery.

In order to excise the tonsillar area more widely, Mikulicz,[37] Langenbeck,[26] von Bergman[1] and Kocher[24] advised a vertical section of the mandible just anterior to the ascending ramus and a disarticulation of the ascending ramus and its removal with a portion of the lateral pharyngeal wall, including the tonsil and the growth. Sedillot's[46] exposure for cancer of the tongue was also recommended—sectioning the lower lip and mandible at the symphysis, the incision being continued backward in the floor of the mouth to the anterior tonsillar pillar, after which the mandibular fragments could be retracted laterally to obtain access to the tonsillar area. Another approach to the tonsil was by a lateral pharyngotomy,[7] the opening being made through the side of the neck without incising the cheek. Such an operation has recently been popularized[51] for various malignant growths of the pharynx. Jacobson took exception to Butlin's statement that simple tonsillectomy was the most suitable operation for cancer of the tonsil and maintained that the more extensive operations produced the longest periods of survival. Despite Jacobson's staunch support of the more radical procedures, however, he was able to report only one cure (eleven years) among an unstated number of his own cases. Eggers[16] has recently described and

advocated several of these old technics with no essential modifications, but he includes no cures nor case reports.

In the final analysis, one must conclude from its history that the operative treatment of cancer of the tonsil justifies Despons' epithet of "surgery of despair."[13] The reasons for the failure of surgery in cancer of the tonsil are, first, that the primary lesions are extensive and inoperable when first seen and, second, that 75 per cent of all cases have metastases on admission. Even though both the primary lesion and the cervical metastases were operable (as is rarely the case), the prudent surgeon will concede that a wide excision of the tonsillar tumor through the mouth cannot be combined safely with a block dissection of the neck at the same operation, nor can the block dissection be performed safely until at least partial healing has occurred in the pharynx. Such a delay would usually result in allowing the cervical metastases to become inoperable. Furthermore, it would be injudicious to combine block dissection of the neck with lateral pharyngotomy; and if the pharyngotomy were done first, the scarring of the neck would preclude the performance of an adequate neck dissection subsequently. As we have already mentioned, simple tonsillectomy had been performed in fifteen cases of the present series before the patients were admitted to our clinic. Of these, four patients had no recurrence in the tonsil and, superficially considered, these successful results might be considered surgical cures, except for the fact that all were treated for cervical metastases and the tonsillar area was included in the beam of radiation exactly as if the growth in the tonsil had never been removed. The cure rate in these fifteen cases (27 per cent) is better than the average, which is undoubtedly due to the fact that all were obviously relatively early when first treated.

While surgery offers little, radiation therapy is particularly suitable in tonsillar cancer. This area is accessible to irradiation both through the skin of the neck and through the mouth by a peroral portal. Cancer of the tonsil, in general, is among the more radiosensitive of pharyngeal and oral tumors, and the upper portion of the pharynx, in contrast to the hypopharynx, can be heavily irradiated without seriously impairing any vital function or bringing on grave complications. The most frequent site of metastasis in cancer of the tonsil is the subdigastric lymph node which lies in the upper deep cervical region only a little below the level of the tonsil itself. This almost direct superposition of the first and most frequently involved

lymph node permits of the irradiation of both the primary lesion and the metastases through the same portal, which avoids the use of portals so large as to tax severely the patient's general tolerance. By contrast, in cancer of the nasopharynx the primary lesion and the metastases are widely separated and each must be irradiated through individual portals, thereby resulting in a greater tax upon general tolerance.

The first form of radiation treatment for tonsillar cancer was the implantation of seeds or interstitial needles.[21] At the Memorial Hospital Janeway and Quick,[21,41] in 1917, employed bare glass radon seeds interstitially, supplemented by moderate doses of external radiation (radium packs or x-ray). With the development by Coutard[11] of the principle of fractionated x-radiation, this growth was one of the first in which the method was found successful. Berven,[2] in 1931, reported success by the use of fractionated doses of radium element pack. He has also published the description of an elaborate device for holding radium plaques in contact with the tonsil, which to us does not seem practical for a number of reasons.

Beginning about 1930, we attempted at the Memorial Hospital to sterilize tonsillar growths by the use of fractionated x-radiation. Further experience has revealed that permanent regression by this method alone often necessitates pushing the dosage beyond the limit of the patient's immediate general tolerance or beyond the point at which the local tissues will recover to an acceptable degree. It has since been found that the number of permanent cures can be increased and the percentage of untoward sequelae reduced by using submaximal doses of fractionated x-radiation, supplemented in most cases by the implantation of small doses of radon seeds in the residual tumor, either directly into the primary lesion or in immediately adjacent metastatic nodes.

A review of the recent publications on tonsillar cancer reveals some diversity of opinion as to the preferable method of treatment.[6,12,18,19,22,23,28,34,43,47] The method most commonly advised is fractionated x-radiation and next in order is fractionated treatment by radium element packs. A minority recommend radon needles or seeds alone or combined with surface applications of radium. Among these authors, only those who depend mainly upon fractionated radiation by x-ray or radium element packs report five-year cures.

General Hygienic Measures. The adequate radiation treatment of any form of pharyngeal cancer is a severe tax on the patient's

general strength. In the larger growths there is almost always a marked local sepsis; and if swallowing has been painful, there is at least some degree of malnutrition. The convalescence may be short-
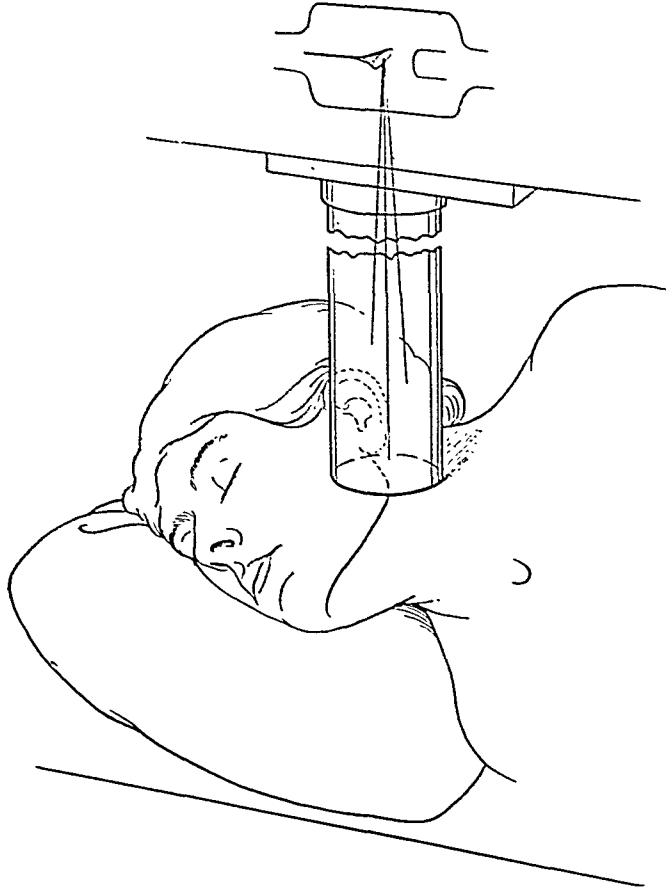
FIG. 3. In external radiation of the tonsil, the skin portal should be centered about over the angle of the jaw and the beam pointed horizontally toward the opposite angle. Accuracy in treatment is favored by metal cylinders which exactly determine the size of the portal and remain in contact with the skin, steadying the patient during treatment.

ened and the severity of the complications greatly reduced if the patient can be hospitalized for a month or six weeks during and immediately following radiation treatment. If hospitalization is not practicable during this long a period, it should be arranged for at least two weeks during the height of the reaction. At the beginning of treatment, measures should be taken to counteract the various complications which may already be present, as we shall discuss presently under "Complications."

Treatment of the Primary Lesion. Treatment should begin with fractionated external radiation given through the cheeks and sides of the neck and, provided that the lesion does not extend downward onto the pharyngeal wall, peroral x-radiation through the open mouth. To irradiate the tonsil, the external portals should be centered about at the angles of the mandibles (Fig. 3), the exact position varying with the individual case as determined after careful examination. Metastases are most often located over the carotid bulb (2 to 2.5 cm. below and a little behind the angle of the mandible), in which case the portal should be slightly larger (8 rather than 7 cm.) and centered nearly over the node with the beam tilted upward and forward toward the tonsil. Even though the position of such an external portal may seem fairly obvious, in relation to some fixed anatomic structure, nevertheless we find it of advantage to mark the center of the portal accurately by tattooing with India ink.* The external portals should be circular in order to be most efficient,† and the size should be about 7 cm. in diameter unless there are definite reasons for making it larger, such as the widespread distribution of cervical nodes or an unusually large primary lesion, when the portals may be 8, 9, 10 cm. or more in diameter. Ordinarily, if a portal must be over 8 cm. in diameter, it is of advantage to make it oval rather than circular, so as to avoid as much as possible the irradiation of an unnecessarily large volume of tissue.

If the primary lesion is of average size and confined to the tonsil itself, and if the jaws can be separated widely enough to admit a cylinder at least 4 cm. in diameter, peroral x-radiation should also be given. For this purpose, metal cylinders of various diameters are used, specially equipped with master cylinders so that the desired size and distance may be selected for the individual case. One of us (M.) has already published a description of such applicators and their several indications.[29a] Recently we have devised an electrically lighted periscope which permits checking the accurate centering of

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* The skin is cleansed by rubbing with alcohol, and a small drop of India ink is placed at the desired point. With a sterile sharp needle, six to eight punctures are made through the ink into the skin, and the excess ink wiped off. The tattoo mark will remain permanently, and its size depends on the number of punctures. If later considered unsightly, it may be excised through a small ellipse.

† Square and circular portals of equal diameter are about equally efficient if centered over a deep-lying mass, since the edge of the beam at its closest point is at the same distance from the edge of the tumor in either case. The area of a square is 25 per cent larger than that of an inscribed circle, and therefore a circular portal is to be preferred since it accomplishes the same result with a smaller area.

such peroral portals by indirect vision. (Fig. 4.) It is fortunate if the patient is edentulous in the beginning; but if not, we believe that the
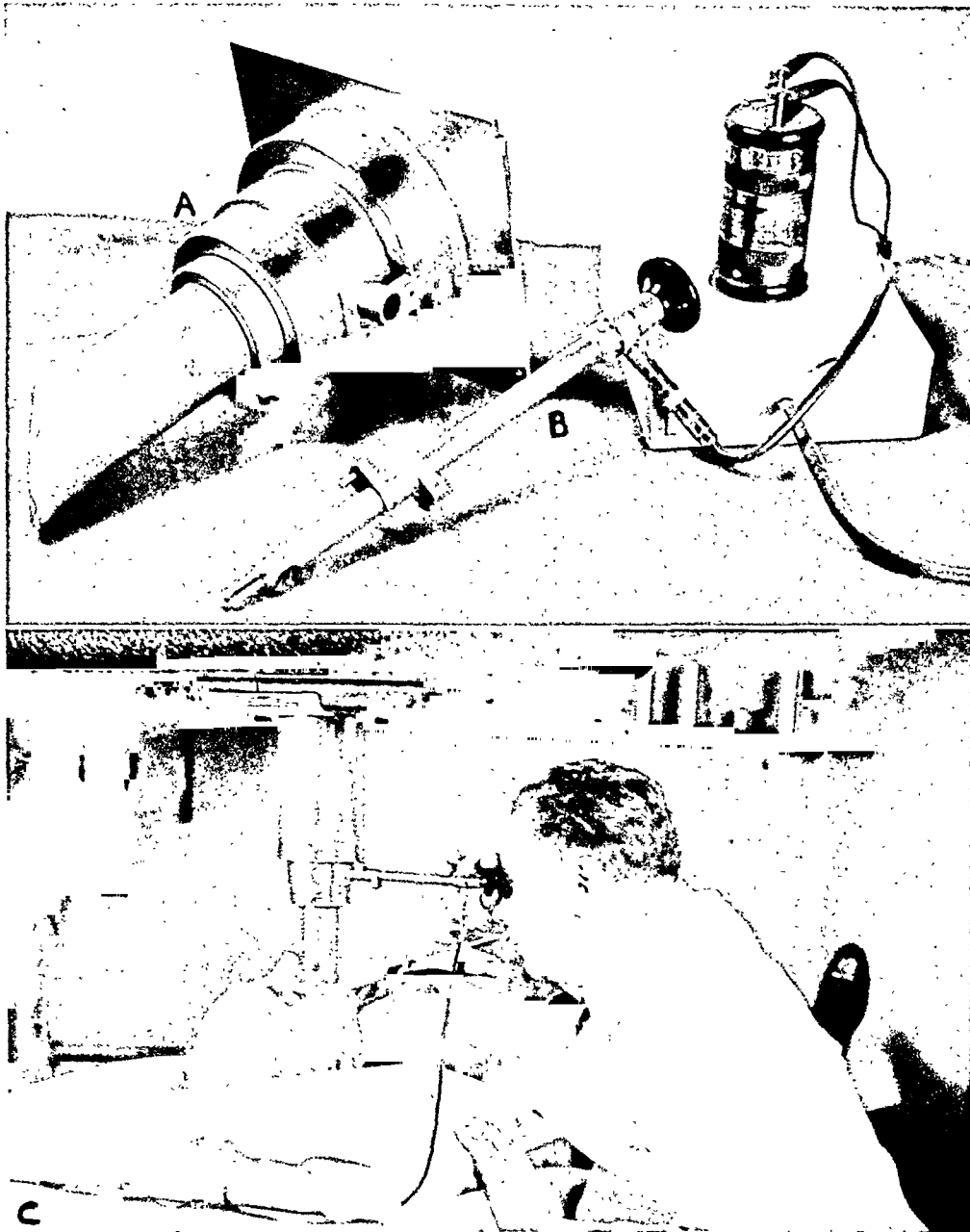
FIG. 4A, B, C. For descriptive legend see opposite page.

extraction even of sound teeth is justified when peroral x-radiation is indicated and there is no other impediment to its administration.

With portals averaging 7 to 8 cm. in diameter (other factors being: 200 to 250 kv., 50 to 60 T.S.D., filter 0.5 to 1.0 mm. Cu) the

X-RAY TUBE HOLDER

EYEPIECE

LENS   LIGHT

TUMOR
IN TONSIL

FIG. 4D.
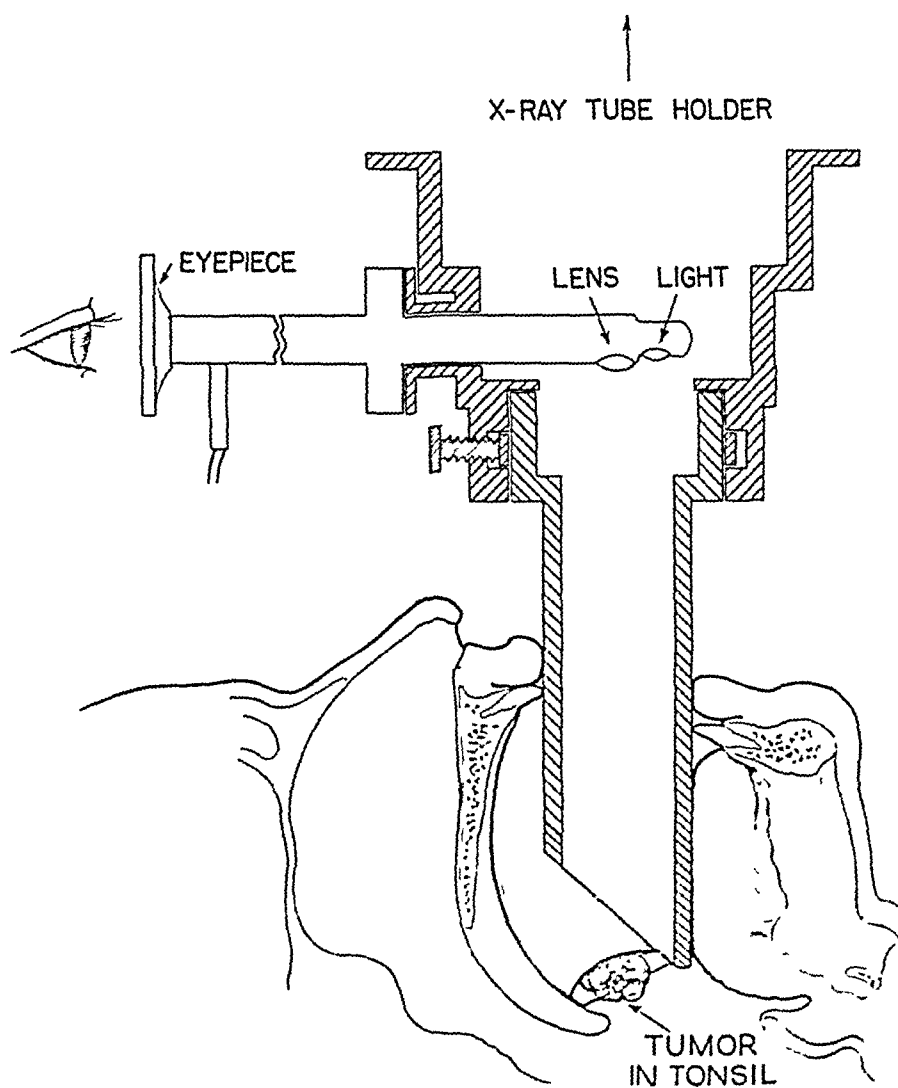
Fig. 4. For peroral x-radiation, a useful attachment is an electrically lighted periscope by which the accurate centering of the peroral cylinder over the lesion may be checked at the completion of the setup. A, master cylinder with a peroral cylinder attached, B, electrically lighted periscope; C, checking the accuracy of a peroral setup with the periscope; D, diagram of construction of peroral cylinder and electrically lighted periscope. (The lens system and periscope were made by the American Cystoscope Makers, Inc., New York City, and all other attachments by Mr. A. Schreiner, Master Mechanic of Memorial Hospital, New York City.)

daily dose should be about 350 r given to alternate sides until a dose of about 3,500 r times 2 has been administered. If a peroral portal can also be used, the single dose with a 4 cm. portal should be about 400 r

THE INFLUENCE OF HISTOLOGIC GRADE ON CERVICAL METASTASIS IN CANCER OF THE TONSIL

TOTAL NO. OF CASES	SQUAMOUS CAR.	CASES WITHOUT MET.	CASES WITH MET.	% WITH MET
6	GRADE I	5 ☐ 1		16
61	II	18 ☐	43	70
20	III	4 ☐ ■ 16		80
1	IV	▌ 1		100
	TRANS. CAR.			
3	GRADE II	▌ 3		100
9	III	1 ▊ 8		88
7	IV	▊ 7		100
7	LYMPHOEP.	1 ▊ 6		85
20	LYMPHOSAR.	■■■ 20		100
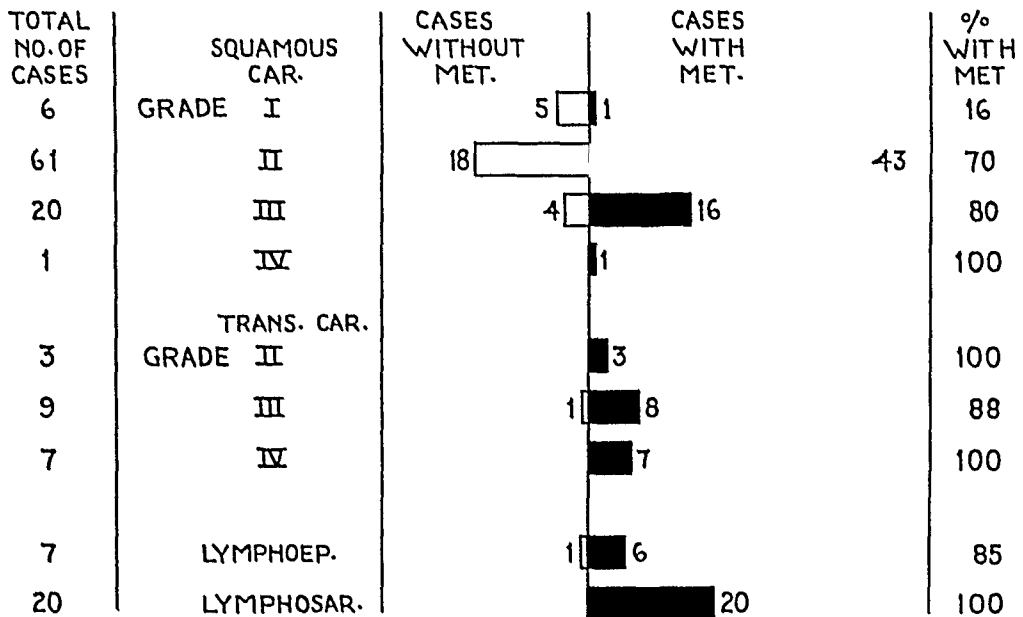
CHART 1. The frequency of metastases in cancer of the tonsil varies with the histologic grade of the tumor from 16 per cent in squamous carcinoma grade 1 to 100 per cent in squamous carcinoma grade IV, transitional cell carcinoma and lymphosarcoma.

given in rotation with the external cheek portals, the total dose being about 2,500 r times 2 through the cheek portals and 2,800 r through the peroral portal. After the completion of such dosage by one or the other of the above mentioned plans, it should be decided whether the depth of the reaction and the degree of regression of the tumor indicates continuing with the external radiation beyond this point or whether further treatment should be given by radon seeds implanted in the metastatic nodes and also in the primary lesion. By external radiation alone, using two skin portals 7 to 8 cm. in diameter and with the other factors as above mentioned, the total dose may be raised justifiably to 4,000 r or even 4,500 r times 2. If a peroral portal is used in addition, the total dose may be as high as 3,000 r or 3,500 r times 2 plus 3,500 r through the peroral portal.

A better plan than either one of these is the administration of external radiation until the tumor has been reduced to a quarter or a

fifth of its original size after which supplementary treatment is given with radon seeds. By such supplementary radon treatment, many of the undesirable effects of large doses of x-radiation may be eliminated. The dose of supplementary seeds is somewhat empiric. A residual mass of cancer 1 cm. in diameter within a heavily irradiated pharynx should obviously not require the same additional tissue dose as if no external irradiation had already been given; but on the other hand many of these residual masses, although only a fraction of the original tumor, are much more radioresistant than the original tumor appeared to be at the beginning. One must not be too sanguine, therefore, in the hope that such masses will disappear under very small supplementary doses. In the average case the strength of the individual seeds should be between 1.0 and 2.0 mc., and they should be geometrically distributed throughout the residual mass, spaced about 1 cm. apart. Since the requirements in individual cases are obviously so variable, it is impossible to give more accurate recommendations for this type of therapy, but some estimate may be made from a review of the dosage in the present series.

The method of treatment most often successful (22 per cent cure rate) was external radiation alone with portals from 7 to 9 cm. in diameter, the dose varying between 2,000 r times 2 and 4,200 r times 2, and averaging about 3,600 r times 2. This observation must not be misinterpreted, however, for these were the more radiosensitive lesions which promptly cleared under the external radiation so that interstitial radiation was not considered necessary. X-radiation and supplementary seeds were used in sixty-one of the determinate cases, with a cure rate of 11 per cent. Superficially considered, such treatment might appear much less successful than that first mentioned, except for the fact that these growths were actually among the more radioresistant and bulky lesions which did not completely regress under the average dose of external radiation. All advanced cases with widespread nodes were treated by this method, thereby bringing down the percentage of cures. The average dose of external readiation in these cases was higher (between 3,500 and 4,500 r times 2), and the doses of seeds into the tonsil in the successful cases ranged between 10 and 16 mc. The radium element pack was used as the source of external radiation in a few cases, the dose ranging from 80,000 to 120,000 mghrs. times 2 with portals 7 cm. in diameter, a R.S.D. (radium skin distance) of 10 cm., and a filter of 2.5 mm. brass (equivalent). In most of these cases there was a supplementary dose

of radon seeds varying between 10 and 20 mc. Radon seeds alone were successful in two instances of smaller lesions treated by fairly heavy dosage, about 15 mc. each in two cases and 31 mc. in one case.

Treatment of Minor Salivary Gland Tumors of the Tonsillar Pillars. Mixed tumors and adenocarcinomas histologically resembling those of the parotid gland and submaxillary salivary glands not uncommonly arise in the minor salivary glands of the oral and pharyngeal mucous membranes. It is well known that these tumors are most common in the hard and soft palate and rare in the tonsillar pillars or tonsillar fossae. There are several such instances on record at the Memorial Hospital, although none occurred in the present series. They usually develop as globose or ovoid tumors which tend to remain encapsulated or sharply delimited until they have reached a size of several centimeters. Those which histologically resemble mixed tumors are essentially benign. The more cellular adenocarcinomas, although encapsulated at first, may metastasize widely to bones and viscera, often skipping the cervical lymph nodes. When occurring in the tonsillar region, these tumors are usually several centimeters in diameter, seldom ulcerated, with a history of several months or even years with very slight symptoms. The painless rounded swelling in the tonsillar region often suggests low grade peritonsillar abscesses anatomically, and these lesions are often incised for purposes of drainage.

Practically all of these minor salivary gland tumors are highly radioresistant from the anatomical standpoint and can be safely enucleated, preferably by cautery and blunt dissection. There are two such successful cases in the records of our clinic, but none occurred in this series. Preliminary ligation of the external carotid artery should be done if the tumors are large and deeply seated. One case at the Memorial Hospital was treated by massive doses of interstitial radon sufficient to produce rather widespread radionecrosis. The patient recovered and has remained well for more than ten years. It is obvious that such treatment by caustic doses of radiation is not justified if these tumors can be enucleated.

Treatment of Cervical Metastases. As has been previously mentioned, metastatic cervical nodes were clinically demonstrable on admission in 76 per cent of the present series. It is obvious, therefore, that no plan of treatment for cancer of the tonsil is adequate which does not provide for the management of this complication as well as the primary lesion. As has been previously stated, it is fortunate that

the most frequently involved node, and often the only one in this disease—the subdigastric—lies only a little below the level of the primary lesion, so that both can be irradiated by the same beam of

TABLE II

MILLICURIES IN GOLD SEEDS REQUIRED TO DELIVER SPECIFIED DOSES TO MASSES
OF VARIOUS DIAMETERS

Skin Erythema Doses	Diameter of Mass—Centimeters											
	1 0	1 5	2 0	2 5	3 0	3 5	4 0	4 5	5 0	6 0	7.0	8.0
	Number of Millicuries											
5	1 0	2 5	4 0	7 5	10	12	14	17	20	27	35	45
6	1 2	3 0	4 8	9 0	12	14	17	20	24	32	42	54
7	1 4	3 5	5 6	10	14	17	20	24	28	38	49	63
8	1 6	4 0	6 4	12	16	19	23	27	32	43	56	72
9	1 8	4 5	7 2	14	18	22	26	31	36	49	63	81
10	2 0	5 0	8 0	15	20	24	29	34	40	54	70	90
11	2 2	5 5	8 8	17	22	26	32	37	44	59	77	99
12	2 4	6 0	9 6	18	24	29	35	41	48	65	84	108

x-radiation. In our series, in about 40 per cent of those patients who had clinical metastases on admission, the nodes were limited to this area. Were it not for this fact, the cure rate in tonsillar cancer would be even lower than it is at present.

Under the above mentioned plan, the external irradiation of the most frequent metastases and of the primary lesion is carried out simultaneously and through the same portal. A decision as to the necessity for supplementary seeds in the cervical nodes and in the primary lesion should be made on the completion of a submaximal dose. In most cases it will be found that cervical metastases will not regress completely under average or even under large doses of external radiation, and supplementary seeds are indicated for the involved lymph nodes more often than for the primary lesion. The seeds may be inserted either through puncture wounds in the skin or after cervical exposure of the outer surface of the node. The dosage is somewhat empiric and depends both upon the size of the residual node and upon the amount of external radiation previously given. A tissue dose of 5 to 6 S.E.D. (as calculated from Table II) should be sufficient as a supplementary dose, but 8 to 10 S.E.D. should be used if seeds alone are employed without preliminary x-radiation. The successful doses in the present series after external radiation ranged between 9 and 22 mc. In the present series eight patients with histologically positive nodes (proved by aspiration biopsy) remained free of disease for a full five-year period after irradiation therapy. It would be misleading to compare the percentage of successful results obtained

by radiation treatment of metastatic cervical nodes in this series with those obtained by surgery, since it is obvious that those treated by radiation included the less favorable and advanced cases, while those treated by surgery were selected cases and limited to those patients who developed metastases only after complete control of the primary lesion by irradiation.

In the treatment of tonsillar cancer, if a metastatic node lies below the upper deep cervical region, it may in some instances be permissible to use a large portal to include the primary lesion and one or more scattered nodes. In the average case, however, we believe it best to treat widely separated nodes by individual portals 3.5 to 5 cm. in diameter, the size of each being just large enough to include amply the individual node. Treatments may be given on alternate days for a total dose of 7,000 to 8,000 r to each node through such small portals, and after about three weeks a supplementary dose of radon seeds implanted.

In tonsillar cancer, neck dissection is of little practical value in the treatment of cervical metastases which are present at the time of admission. It is obvious that neck dissection cannot be carried out safely in conjunction with adequate irradiation of the primary lesion. Neck dissection is occasionally indicated in large metastases occurring some months after healing of the primary lesion. The choice between neck dissection and radiation in such cases depends upon the judgment, experience and ability of the individual surgeon with the two methods and the equipment available. In the present series, five patients in whom metastases developed several months after the treatment of the primary lesion were treated by neck dissections. In three, the excised nodes were found to be histologically positive, and of these one remained well for a period of five years.

COMPLICATIONS

Heavy protracted irradiation through large portals to any part of the body is always followed by a chronic radiation sickness. When large fields are used over the neck or cheeks, such an effect is one of the most serious complications, and it may occur in the absence of any intense local tissue reaction such as skin blistering. The patient becomes listless, weak, toxic, loses weight and becomes cachectic. These symptoms are not due entirely to the local discomfort, dysphagia or reactions in the skin or mucous membranes, but probably arise in part as the result of toxic absorption from the large volume of

tissue irradiated as well as from the partial derangement in the function of the various vascular, glandular and nerve structures of the neck. Many cancer patients who receive heavy irradiation therapy undoubtedly die more from the effects or radiation than from the disease itself. Such systemic effects of radiation can be largely prevented by avoiding unnecessarily large portals. In pharyngeal cancer the portals seldom need be more than 7 or 8 cm. in diameter, and with such portals the local intensity may usually be safely increased so as to reach a cancer lethal dose. The use of portals 12 to 14 cm. in diameter or larger in the pharynx, whether or not required by the extent of the disease, is always indicative of an unfavorable prognosis.

The Acute Effect in the Skin and Mucous Membranes.   The skin of the neck and the mucous membranes of the pharynx, which are directly exposed under the beam of radiation, should in all cases show an acute blistering or epidermicidal reaction within the first month of treatment. This degree of reaction is usually necessary if roentgen radiation is to produce a lethal effect on a tonsillar tumor. The depth of the cutaneous reaction may seem alarming in appearance, but one may be assured that such a reaction produced by repeated x-ray treatments over a period of fifteen to thirty days always heals under proper care without any serious sequelae. Under fractionated x-radiation by the technic already described, the typical reaction begins after about a week with a mild erythema which becomes deeper but remains dry and sometimes slightly pigmented during the second week. About the fifteenth to twentieth day, the superficial or epidermal layers of the skin become slightly raised by serum, and the corium, being denuded (at first over only scattered areas), becomes a deep red weeping raw surface which bleeds on slight trauma. After a few days the entire area of skin exposed to the direct beam may be denuded of epidermis. While the skin is in a dry state, frequent applications of petrolatum or liquid petrolatum should be used with no other dressing. When the surface is denuded, it should be kept covered with a single layer of fine mesh gauze bandage impregnated with petrolatum, boric acid ointment or the following hydroscopic ointment:

	Parts
Hydrous wool fat	2
Zinc oxide	1
Starch	1
Liquid petrolatum sufficient to make a soft paste	

The raw surface should be sponged daily with sterile saline solution to remove the exudate, and the surrounding normal skin should be cleansed with soap and water and alcohol. If the raw surface is protected from dryness, crusting, trauma and secondary infection, it ordinarily heals completely in from ten to fourteen days, leaving a soft pliable skin in which moderate telangiectasis may or may not later appear.

The mucosal reaction, a counterpart of that in the skin, should go on to a membranous mucositis of diphtheritic appearance in the tissues exposed to the direct beam. Although not painful while the part is at rest, this lesion is tender on movement and bleeds slightly but easily if the membrane is disturbed. It reaches its maximum in about twenty or thirty days after the beginning of treatment and usually disappears in ten or fifteen days, its duration depending on the size of the total dose. When radon seeds are used to supplement the external radiation, this type of reaction becomes more acute in the neighborhood of the implantation. During its height there is considerable serous and mucoid discharge from the surface, with a diminution in the quantity and an increase in the viscosity of the saliva. If the condition is not relieved, the accumulation of these secretions is the cause of a great deal of discomfort.

As a matter of routine at the beginning of treatment, irrigations of the throat should be given every two hours with an irrigating can equipped with a rubber tube and glass nozzle. A warm solution of sodium bicarbonate and water should be used. The patient is instructed to take the irrigation at night if he wakens and notes marked discomfort. This single procedure affords considerable relief, as is proved by the fact that it is voluntarily continued by the majority of patients without further urging. The viscidity of the secretions is greatly relieved as soon as the mucositis clears, but dryness of the mucous membranes may persist in a lessening degree for several years after treatment, a complication which will be discussed under "Xerostomia." The reaction of the mucous membrane is partly responsible for the dysphagia which sometimes occurs.

Dysphagia. This complication is always present to some extent when an acute radiation reaction is produced in the pharynx. Even though the disability is only moderate, it still may be responsible for a marked loss of weight and strength in a nonco-operative patient. The patient should be instructed as to the necessity for maintaining his weight and nutrition, and should be encouraged to take an

adequate balanced liquid diet of high caloric value. If necessary, a rubber feeding tube (No. 16 French urethral catheter) may be inserted through the nasal cavity down into the esophagus and left for a period of several days during the height of the reaction. We have found that most cancer patients who must subsist on even the most intelligently prepared liquid diets are benefited by supplementary liver and vitamins (especially B and C). One teaspoonful of liver extract powder may be given two to three times daily or two to three heaping tablespoonfuls daily of dried yeast may be dissolved in the liquid feeding. Fresh fruit juices supply vitamin C.

Pain. As we have previously mentioned, pain is one of the earliest symptoms in cancer of the tonsil. If the disease is uncontrolled or if radionecrosis and local sepsis occur, the pain in the local area may eventually radiate to the ear or to the whole side of the head. When these complications are also associated with uncontrolled, deeply infiltrating cervical metastases, the continual intractable pain may be so severe as to be a cause of death from exhaustion. Neurolysis by alcohol is not suitable in this area since not only is the fifth cranial nerve involved, but also the seventh and ninth and often the upper cervical sensory roots. Localized pain on admission due to sepsis and to pressure by the growth in the tonsil is often partly relieved by hot throat irrigations and tends also to diminish as the tumor regresses under radiation therapy. Late radionecrosis is almost always associated with pain radiating to the ear over the chorda tympani. Since in all intraoral cancer the pain is apt to continue for several weeks before complete relief is obtained, attempts should always be made in the beginning to obtain relief by such milder sedatives as codeine in doses of ½ gr. (30 mg.) and acetyl salicylic acid 10 gr. (600 mg.) given every six to twelve hours, increasing the number of daily doses at first and finally increasing dose to 1 gr. (60 mg.) of codeine if necessary after two to three weeks when the patient becomes accustomed to the drug. Morphine should be reserved for the advanced stages or for acute transitory conditions since, once established, the morphine habit can be broken only with difficulty and is often the cause of more suffering than the cancer itself.

Radionecrosis and Osteomyelitis. There is a widespread erroneous belief that radionecrosis depends entirely upon the intensity and quality of the radiation. As we[296] have previously pointed out, radionecrosis at a depth never occurs except when infection is introduced,

no matter how heavy the radiation dose. If a mass of tissue at a depth is completely devitalized by irradiation (or by any other physical agent) and no local infection occurs, the devitalized mass will be absorbed or replaced by fibrous tissue or will calcify and be tolerated locally as any form of sterile foreign body. If infection is introduced, the phenomenon generally known as radionecrosis occurs, and the devitalized mass suppurates and must be completely extruded before healing can take place.

Since infection is always present on the surface of the skin or mucous membranes, superficial radionecrosis occurs in superficial growths with greater frequency than with those at a depth. In the tonsillar area, infection is always present in ulcerated tumors and may also be present in the depths of the tonsillar crypts, so that the conditions favorable to slough are unusually frequent. Radionecrosis may occur after heavy external radiation alone, but the incidence is increased by the use of interstitial radon both because of the possibility of too great concentration of the radiation effect and because infection may be introduced during the insertion of the seeds. A small volume of radionecrosis in the upper part of the pharynx or oral cavity is compatible with an excellent end result. The greater the volume of the slough, the greater the chance of erosion of such vital structures as blood vessels.

When the soft tissues have been eroded by necrosis, heavily irradiated bone of the mandible may be exposed and osteomyelitis results, a complication which occurred in seven of our patients, one of whom required a partial resection of one ramus of the mandible. Of these seven patients, three remained alive and well for five years.

In treating this complication, the slough should be gently manipulated every day, the loosened portion removed and the more adherent clipped away with scissors. No aggressive attempt should be made to clear out all necrotic tissue. In these cases, careful attention to oral hygiene by irrigations and gargles is particularly important.

Practically all necrotic lesions of the oral cavity are produced by anaerobic saprophytic organisms for which oxygenic applications are specific. The average preparations, such as sodium perborate and hydrogen peroxide, are too transient in their action, but the use of zinc peroxide (marketed under the name "Z. P. O.") as recently introduced by Meleney[35] will often clear the offensive odor and improve the appearance of the ulcer within a few hours. Sunderland

and Binkley[50] have recently reported upon the use of this substance for necrotic intraoral cancer in our clinic. In brief, the necrotic cavity is packed once or twice daily with gauze saturated by a suspension of zinc peroxide in water.

In the present series, radionecrosis or slough appeared as a complication in twenty-nine cases (20 per cent), and 14 per cent of these patients recovered and remained free of disease for five years, a figure only a little below the average cure rate (18 per cent). This complication does not appear to have been absolutely determined by the size of the radiation dose, either in x-radiation or in seeds. It occurred in one instance after a dose of only 3 mc. in seeds and was absent in another instance after 50 mc. in seeds supplementary to 80,000 mghrs. times 2 to the neck with the element pack. One of the most serious concomitants of radionecrosis is hemorrhage.

Hemorrhage.   The blood supply of the tonsil arises from several sources: the tonsillar and the ascending palatine branches of the external maxillary artery, the dorsalis linguae branch of the lingual artery, the descending palatine branch of the internal maxillary artery and the ascending pharyngeal branch of the external carotid. Most of these vessels anastomose freely in the tonsillar fossa. The largest and most important from the standpoint of hemorrhage is the tonsillar branch of the external maxillary (facial) artery, which passes upward between the internal pterygoid and the styloglossus and pierces the superior constrictor to enter the tonsil on its lateral surface.

Hemorrhage is most likely to occur when there is deep slough which approaches the lateral surface of the tonsil, and immediate bleeding is ordinarily readily controlled by digital tamponage until arrangements can be made (within a few hours) to ligate the external carotid artery and its lingual and facial branches. The first hemorrhage is seldom fatal, but when the necrosis has become so deep and extensive as to cause even moderate bleeding, the erosion of several adjacent vessels, such as the internal carotid or the jugular vein, may soon occur so that the eventual prognosis is grave. In the present series, hemorrhage occurred in sixteen cases, in seven of which the loss of blood was considered sufficiently severe to require ligation of the external carotid and its branches. In all seven of the latter cases, subsequent hemorrhages occurred from other vessels following these ligations, and all cases eventually terminated fatally. Obviously the deaths in these cases were not due to the effects of the ligation of the

external carotid, for it is a well known fact that ligation of one or even of both of these arteries is not a serious procedure.

Edema of the Hypopharynx.   This complication should seldom occur after proper radiation treatment of tonsillar cancer except when metastases are widespread through the neck so as to necessitate the use of portals 12 to 15 cm. in diameter. As we have previously mentioned, the use of such large portals, whether necessary or not, is always indicative of a poor prognosis. The occurrence of edema in the hypopharynx following irradiation treatment of tonsillar cancer with nodes limited to the upper deep cervical region should be a reproach to the radiologist who has given the treatment. In the present series, edema of the hypopharynx occurred in some of the earlier cases when we did not appreciate the disadvantages of large portals. In the more recent cases, it has occurred only when large or multiple portals were necessary because of widespread metastases extending to the lower portion of the neck.

Xerostomia.   The palatine tonsil lies under the anterior edge of the parotid salivary gland in the horizontal coronal plane. A portal even as small as 7 cm. in diameter will, therefore, include the greater part of the parotid salivary gland as well as a portion of the sub-maxillary salivary gland. When cancer lethal doses are administered to this area, the secretory function of these glands is markedly diminished. The mucous membrane of the upper portion of the pharynx contains numerous minor salivary and mucous glands which, with the saliva, serve to moisten and lubricate the mucous membranes of the oral cavity and pharynx. For these reasons, adequate radiation therapy of tonsillar cancer is always followed by some degree of xerostomia. The saliva decreases in quantity and its viscidity is increased. In such cases, inspection will reveal that the soft palate and pharyngeal walls are rather dry and glistening. Although this complication cannot be entirely avoided, its degree can be markedly reduced by the use of mouth washes and by frequent sips of liquid petrolatum which the patient may carry in his pocket in a small bottle. Chewing gum or holding a lozenge in the mouth seems to stimulate the flow of saliva and to distribute it more widely in some instances. After a year or two, the secretions tend to become more normal although complete function is never entirely restored.

Recurrence.   Following treatment by radiation, even though there is apparent complete regression and healing of the primary lesion, local recurrence may take place within a month or even after

TABLE III

FACTORS INFLUENCING THE PROGNOSIS IN 148 CASES (DETERMINATE GROUP) OF CANCER
OF THE TONSIL

1931 to 1935, Inclusive

	Total Number of Cases	Number of Five-year Cures	Per Cent of Five-year Cures
Age in years:			
Below 40 . .	16	2	13
41 to 50	20	5	25
51 to 60	41	6	15
Over 60	69	12	17
Not stated	2	1	
Sex:			
Males	125	20	16
Females	23	6	26
Size of lesion:			
1 cm. or less	2	0	0
1.1 to 2 cm	10	4	40
2 1 to 3 cm	46	7	15
3 1 to 4 cm	25	5	20
Over 4 cm	33	3	9
Not stated	32	7	22
Metastases (histologically proved):			
None at any time ..	34	13	38
None on admission .	37	14	38
Present on admission	111	9	8
Developed after admission	3	1	33
Present some time .	103	10	10
Histopathology: (primary)			
Squamous cell, grade I	4	1	25
Squamous cell, grade II	59	8	14
Squamous cell, grade III	19	2	11
Squamous cell, grade IV	1	0	0
Squamous cell, ungraded	9	4	44
Transitional cell grade II	2	1	50
Transitional cell grade III	~	3	43
Transitional cell grade IV	6	0	0
Lymphoepithelioma	~	1	14
Lymphosarcoma	20	4	20
Unclassified	14	2	14
Status of disease on admission:			
Residual, recurrent, and metastatic after treatment elsewhere to primary:			
After radiation	10	0	0
After surgery	12	2	16
After combination	4	1	25
After endothermy	4	1	25
	30	4	14
Primary cases, no treatment elsewhere .	118	22	19

[33]

as long as a year. In the present series such recurrence appeared in twenty-four cases, the majority (fourteen cases) between the fourth and sixth month, although five occurred after one year. In this group there were no five-year survivals, although curative attempts were made in all cases by supplementary treatment—in a few cases by further x-radiation, but in the majority by additional implantation of radon seeds in the areas of recurrence. The chief reason for the bad prognosis in recurrent cancer of the tonsil undoubtedly lies in the fact that the local tissues of the pharynx and neck have already been so heavily irradiated that the tolerance to irradiation has been exhausted, and that further attempts are invariably followed by fatal complications or persistent cancer. Following heavy irradiation there is no such thing as complete recovery of the tissues from the standpoint of tolerance to subsequent radiation.

A clinical diagnosis of a recurrent or a persistent growth in the tonsillar area is readily confirmed by biopsy; but the diagnosis is much more difficult in suspected recurrent or persistent cervical metastatic cancer, since following heavy irradiation or surgery there may be indurated masses of scar tissue which cannot always be differentiated clinically from residual cancer except by the subsequent clinical course. In the present series, in at least twenty-four cases after apparent complete regression of the cervical lymph nodes there was recurrence or extension of the growth in the neck. Of these, two remained well for five years after subsequent treatment.

PROGNOSIS

Before the advent of radiation therapy, cancer of the palatine tonsil was considered practically a hopeless disease, and even with modern methods this opinion is still held by many writers. Ducuing,[14] in 1935, stated that except in very rare cases, treatment of malignant growths of the tonsil gives only palliative results of very short duration. While this viewpoint seems extreme, the prognosis is not as favorable as in most other anatomic forms of growth in the oral cavity or pharynx. The reasons for this are fairly obvious. Since the tactile sense in the tonsillar area is not acute, the primary lesion usually reaches a large size before it is detected by the patient. In the present series the average diameter was about 4 cm. on admission. In many other areas of the oral cavity and pharynx the lesions can be discovered much earlier. The advanced stage of the disease in the average case on admission is further indicated by the fact that three-

fourths of the present cases had metastases on admission. The histologic type of the growth is among the most malignant of the oral cavity and pharynx; and even if the primary lesion and cervical metastases are eventually cured, the patient is still under the hazard of generalized dissemination. A review of the older literature reveals an almost uniformly hopeless attitude toward this disease when treated by surgery; for example, Broders,[3] in 1927, stated that in his opinion no definite five-year cure had ever been obtained by surgery. Under radiation methods, the cure rate in the earlier cases is fairly satisfactory as compared to most forms of upper respiratory and alimentary tract cancer. The factors which influence the prognosis are given in Table III, the most significant of which will be discussed separately.

Age. The chance of cure appears to be best between the ages of forty and fifty. The relatively poor prognosis in those under forty (if not a coincidence) is probably due to the more malignant histologic type of growth in younger patients, and in those over the age of fifty to the inability of older patients to withstand the complications of treatment.

Sex. As in most forms of oral and pharyngeal cancer treated by radiation, the prognosis in females (26 per cent) is definitely better than in males (16 per cent). It is our opinion that such findings are due to the fact that cancer in the female is more radiosensitive than its anatomic and histologic counterpart in the male.

Size of the Lesion. As might be expected, the cure rate decreases as the size of the lesion increases. It is noteworthy that in the twelve cases of our series in which the lesion was 2 cm. or less in diameter, four (33 per cent) survived five years, a cure rate twice the average for the whole group.

Metastases. It is apparent that its capacity to metastatsize is the most significant factor in the malignancy of tonsillar cancer. When no metastases were present on admission or when none occurred at any time, the cure rate is almost 40 per cent. When metastases were present on admission, the cure rate is only 8 per cent.

Histopathology. From an analysis of our series it appears that the prognosis in cancer of the tonsil is better in transitional cell carcinoma and lymphosarcoma than in squamous carcinoma. Under radiation therapy this difference might be accounted for, at least in part, by the higher radiosensitivity of these groups. However, lymphoepithelioma which is as radiosensitive as the two above men-

tioned, gives the poorest prognosis of all (only about one-third of the two best groups). Such figures may be due in part to coincidence.

Status of the Disease on Admission. As might be expected, the cure rate in patients who had received no treatment before admission was better (19 per cent) than in those which had been treated elsewhere (14 per cent). Previous unsuccessful treatment by radiation or surgery does not preclude success, however, as is shown by an eventual salvage of four (14 per cent) of thirty recurrent cases.

END RESULTS

The net five-year cure rate in the present series calculated on 148 determinate cases is 18 per cent (Table IV). We have previously

TABLE IV

MEMORIAL HOSPITAL

FIVE-YEAR END-RESULTS IN CANCER OF THE TONSIL

1931 to 1935, Inclusive

This series consists of all patients with histologically proved cases of cancer of the tonsil, both early and advanced, admitted during the specified period. Only those patients are excluded who, for any reason, were unable to return for treatment, palliation and observation in the out-patient department, and those who were lost track of within the first month after no more than one or two visits (clinic shoppers).

Total number of cases...		157
Indeterminate group:		
Dead as a result of other causes and without recurrence...........	7	
Lost track of without recurrence..............................	2	
Total number of indeterminate results.........................		9
Determinate group:		
Total number minus those of indeterminate group...............		148
Failures:		
Dead as a result of cancer....................................	117	
Lost track of with disease (probably dead).....................	5	
Living with recurrence.......................................	0	
Total number of failures in treatment.........................		122
Successful results:		
Free from disease after five years or more.....................		26
Five-year end-results:		
Successful results divided by determinate group (26/148).........		18%

published the method of calculation of end results which is now used at the Memorial Hospital. Briefly stated, the clinical material is

unselected; that is, all patients who apply at the clinic is all stages of the disease are accepted for treatment or palliation and are included for statistical analysis. The only cases excluded are those of patients who, on their own decision, do not return for treatment and are lost track of within the first month. At least a 90 per cent follow-up is insisted upon. In calculating the net end results, those cases are subtracted as being indeterminate when the patients are lost track of or die of other causes not connected with cancer or its treatment after at least a year's freedom from disease.

Duffy[15] has reported on two series of tonsillar cancer which comprise the cases on the Head and Neck Service at Memorial Hospital from 1920 to 1930, with cure rates about the same as in the present report. From a comparison of the percentage of metastases on admission (60 per cent) which he reports in these earlier cases, it appears that prior to 1930 there was some selection of patients, since in the present series the percentage of metastases on admission, 75 per cent, indicates a more advanced average stage of the disease.

There are few reports in the literature which are calculated upon unselected groups of histologically proved cases with a five-year survival period as the basis of cure. Unfortunately, even in the best reports the authors seldom state definitely that the cases are unselected and that none was excluded because of an advanced stage of the disease. Patterson,[40] in 1934, reported nine five-year survivals in forty-one proved cases of cancer of the tonsil treated by endothermy. Coutard,[11] in 1932, reported 18 per cent five-year cures in thirty-three cases. Mathey-Cornet[33] reported 15 per cent five-year cures in seventy-seven cases. None of these authors definitely states that the cases were unselected. Schreiner reports two five-year cures in fifty-one cases, or 4 per cent.

SUMMARY AND CONCLUSIONS

The series herein reported consists of 157 consecutive unselected cases of all patients with cancer of the tonsil, in all stages of the disease, admitted to Memorial Hospital during the years 1931 to 1935, inclusive. The etiology, clinical course, method of treatment, end results and prognosis are discussed in detail. The net five-year cure rate is 18 per cent.

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Editorial

TRAUMATIC SURGERY AND THE WAR OF TOMORROW

IN these days of preparation for another war there is apparently much confusion surrounding the term "war surgery." Doubtless there is similar confusion as to the term "war medicine," but of this I am not competent to speak.

In the Great War, many of us had the opportunity of serving with surgical units of our Allies, and the practical experience then gained served us well when the time came to care for our own wounded. In retrospect, we recall that the actual service of American surgeons with their own army began at Cantigny in May, 1918, and ended in the Argonne, November 11, 1918. This meant only six months of direct contact with our own wounded, and hence many of us served longer with our Allies than we served with our own troops during the actual combat.

The present war differs technically from the last war in respect to the terrain, the type of combat, the increased use of tanks and airplanes, and in many other aspects, including a great increase in the non-combatant wounded. However—and this is is my subject—*the type of injury and the elements of treatment are essentially unchanged.*

Generally speaking, there are always two groups chiefly affected by war: combatants and noncombatants, but the injuries are usually identical. We can group these war injuries into five main classifications:

wounds, burns, fractures, visceral and joint trauma. Differing often as to severity, these are also the prevalent peace time traumas. In the final analysis, trauma registers as the outcome of initial contusion or laceration, plus appropriate complications, of which shock, hemorrhage and infection are the chief. War surgery is traumatic surgery in the mass, and traumatic surgery is only a section of general surgery. In traumatology there is no merit in prefixing a special causative factor, such as industrial surgery, civil surgery, or military surgery inasmuch as there is essentially only one etiologic factor (violence) and only one physical effect (damage). In years gone by, "railroad spine" had a vogue that proved meaningless, just as had the term "shell shock." The factor to be stressed is that "trauma" means "a blow," whatever the surroundings, source, site or sequence. Much has been said as to the gains achieved for traumatology through the experience of the last war. My viewpoint is that the only indisputable gain was the final mass proof of the prophylactic efficacy of tetanus antitoxin.

Antiseptics proved valueless, and as a matter of fact, even the Carrel-Dakin method had been practically abandoned abroad before it became the vogue here. Dakin's solution was the 1914–1918 model of Labarraque's solution of 1814, each of them chlorines. Likewise débridement (de-

rived from the French "débrider," to un-bridle) was supposed to be a new method, but actually the word itself and its connotations belong to the period of the Napoleonic Wars, a century prior to the First World War.

The originator and exponent of débridement was the great French Army Surgeon, Baron Dominique-Jean Larrey, now almost forgotten by us but who was remembered by Napoleon in his last will and testament by a bequest of 100,000 francs "to Larrey, the most virtuous man I have ever known." Strangely enough, Napoleon forgot his Generals but remembered this Surgeon-in-Chief to the Grand Armée who participated in sixty battles and 400 engagements. He was wounded three times, performed as many as 200 amputations in twenty-four hours at Borodino, and originated first aid to the wounded through the medium of the celebrated "flying ambulances."

Of all the elements that mean success in the treatment of the injured, time is of the essence. For many years I have referred to this factor as the "Golden Period" in traumatic surgery, to indicate that an injury should be treated within the first six hours post-trauma. During that period of "lightning attack" our chances of overwhelming the enemy, infection, are greatest, and delay may mean disaster. The analogy in general surgery is apt, for we know that success is usually achieved if we can operate within six hours after the onset of a ruptured appendix, or a ruptured duodenal ulcer.

In this present war, the opportunities for speedier care of the injured will probably be greater because of the terrain, and motor and airplane transport. Likewise the prevalence of gas gangrene and tetanus will be less inasmuch as precombat immunizing will be possible. Streptococcic and staphylococcic infection will largely yield to the sulfonamides, and thus chemotherapy will further reduce our posttraumatic complications.

Fractures of the compound type are a main problem in any war, and I am told that the newer type of shells and bombs are so designed that the burst is distributed closer to the ground, thus the lower limbs will be more often involved. In civil life compound fractures usually occur because the broken bone extrudes (from within out) and thus infection is less often of the buried type. In war fractures, the missile penetrates the soft parts first (from without in), thus carrying infection deeply and damaging the soft part coverage en route. There is also the added factor of infected soil, clothing and skin, all of which mean that every compound fracture is an infected fracture—in reality, potential osteomyelitis. As a matter of proved clinical experience, we have long known that every wound not made with surgical intent is already infected and should be so regarded. Thus in stark reality, *the* enemy is infection, and to be effectively overcome we can place reliance only on two factors: one is the *time* factor and the other the *sterilizing* factor. The *time* factor has already been mentioned; we usually win if we attack in the first six hours post-trauma, and we usually lose if we attack thereafter.

The *sterilizing* factor is also two-fold: We can use débridement (mechanical or external sterilization), or we can use drugs (chemical or internal sterilization)

Débridement is effective when three criteria are attained, namely, normal color, the occurrence of bleeding and muscle contraction, as incidents in the surgical non-sacrificial excision of damaged tissue. *Chemical* security is effective when organisms succumb. Various incidentals in treatment also play a part, one of importance being immobilization, and the other avoidance of re-infection in early or imperfect dressings.

Immobilization is being stressed now as a new phase in the treatment of wounds and fractures, the assertion being that plaster of Paris or other types of inclusion are the chief elements of importance. There is nothing fundamentally new in this assertion inasmuch as it is only a modification of the old principle of rest and splintage. It

is not to be forgotten that adequate sterilization is a preliminary to any type of immobilization. Germs can live only on damaged tissue, and this is now, as always, a guiding principle, applicable alike to civil as well as to war injuries.

The search for the *sterilisia magna* in wound treatment has tormented the profession for centuries and at present the fulfillment of this dream of surgeons is a long step nearer because of the sulfonamides. However, a sterile field is the necessary adjunct, hence surgical asepsis by débridement is still of prime importance.

All these statements seek to stress the fact that ancient surgical axioms still dominate despite exaggerated claims to the contrary on behalf of radical technic, new gadgets, sovereign drugs or changed procedure.

Real advance has been made in traumatology since the last war, and in the first rank I would place the awakening of the profession to the importance of placing injuries in the "treat-them-now" class. A broken bone should become just as much an emergency as a ruptured appendix.

Second in importance, and a corollary of the preceding, is the recognition of the time element; trauma has no incubation period.

Third is the factor of added experience by a greater number of qualified surgeons. In the last war, Surgeon General Ireland truly stated that he had hundreds of surgeons in the Reserve Corps capable of performing a gastroenterostomy, but only a few equally proficient in the management of a compound fracture of the femur. In this war, débridement, chemotherapy and antitoxins will play important rôles. Blood and plasma banks will be more accessible and more effectively used. Intravenous anesthesia will become time-saving, pain-saving and life-saving.

But with all the added advantages in the recognition and treatment of the injured, reliance must still be placed on the fundamentals of surgery, neglect of which will give the victory to one of the Four Horsemen of Trauma: death, disability, deformity and despair.

Let us not forget the lessons of the past in preparing for the future; and let us use the present for reviewing and perfecting the devices of general surgery applicable to traumatic surgery in civil or military zones.

"If every man would mend a man, then all the world were mended."

JOHN J. MOORHEAD

Original Articles

CONSERVATISM IN GASTRIC SURGERY*

A NEW TECHNIC FOR RESECTION

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THE history of gastric operations is similar to that of many other phases in the progress of surgery. Working at first with the exercise of extreme caution, operators gradually grew bolder until radical resection became the rule rather than the exception. The number of operations performed greatly increased. So did the mortality rate.

In preparing a paper published over a year ago,[1] I had occasion to look up the prevailing mortality rates in large clinics where special attention is given to gastric and intestinal surgery. I found that they ran from 15 to 27 per cent. In routine hospital operations where gastric surgery is in the hands of general surgeons who do not intervene upon the stomach very often, the rate rises to 47 per cent or even higher.

This is an alarming situation demanding serious consideration and a determined attempt to reduce these distressing high averages. That a widespread effort is being made in surgical centers is evidenced by many signs. A plea for conservatism in surgery of the stomach made in the paper just mentioned, wherein I particularly emphasized the value of the two-stage procedure, has been widely read and commented upon. So many reprints have been requested that my supply was soon exhausted.

These evidences of approval are personally gratifying, but far more important is the interest in conservative gastric surgery and the trend away from radicalism dis-played in recent papers (Graham,[2] Chaton and Stern,[3] Cutler,[4] Means,[5] Cutler and Zollinger[6]).

In a well thought out article on the surgical treatment of duodenal ulcer, Castleton[7] discusses conservatism versus radical surgery and remarks on the difference of attitude displayed by surgeons upon the European continent and those of North America. He says: "Continental surgeons report a much higher incidence of recurrence of ulceration following gastroenterostomy than do most of the surgeons of this country." It has been shown by operators who "studied specimens of stomach and duodenum resected by Walters in cases of duodenal ulcer . . . that whereas ulceration and hemorrhagic forms of gastritis are frequently found associated with duodenal ulcer in central Europe, they are extremely rare in this country. It was also shown that multiple ulcers are more common abroad than here. . . . This being the case it is easy to understand why conservative surgery should give comparatively poor results abroad."

But though continental European surgeons are continuing to employ radical measures in intervening upon the stomach, as far back as 1906 students of anatomy and organic function were calling the attention of surgeons to certain physiological factors whose existence argued against radical resection of the stomach if it could by any means be obviated. Edkins[8] experimented by boiling with water, acid or

peptone sections of pyloric mucous membrane taken from the lower fifth of the stomach wall. He thus produced a decoction which, when injected into the jugular vein of an experimental animal, brought about secretion of gastric juice. Edkins thus showed that secondary secretion of gastric juice is induced by a chemical mechanism, not by local stimulation of the reflex nervous apparatus of the gastric wall as had formerly been assumed.

The first products of the digestive process serve to set this mechanism in operation. The immediate result of its action upon the mucous membrane is absorption into the blood stream of a hormone which has been named *gastrin*.

This hormone is carried to all the glands of the stomach, its essential rôle being to act as a specific excitant of their secretory activity. Since Edkins made these observations, the presence of gastrin in the mucous membrane of the human stomach has been demonstrated many times. Removal of any considerable amount of the mucosa of the pyloric area must inevitably take away one of the chief factors stimulating the formation of gastric juice. Gastric motility will in turn be lessened and the final functional result of the intervention upon the stomach cannot fail to be disappointing.

Discussing Edkins' observations and their present day application, Rienhoff[9] states that, although we are not sure whether the peristaltic waves of contraction arise independently near the commencement of the pyloric antrum (in the distal four-fifths of the stomach), we are sure (because of fluoroscopic observation) that the lower fifth of the stomach is very much more active than the remainder of the cavity. The surgeon cannot hope to restore normal motor function for his patient if the hormone secreting mucosa of this lowest fifth has been extirpated.

To obviate the difficulties thus created, Rienhoff planned an operative procedure wherein he resects the pyloric antrum or "pacemaker," as he calls it. This partial gastrectomy leaves the major portion of the stomach untraumatized. An anastomosis in front of the colon is then made with a short loop between the stomach and the jejunum.
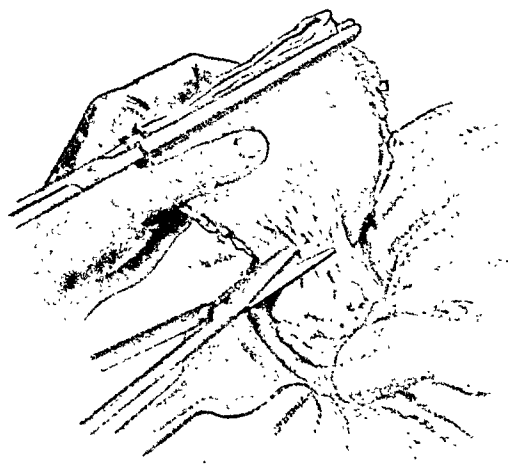
Fig. 1. Cutting the adhesions on the posterior wall of the stomach.

He prefers this short-loop gastrojejunostomy because it is simpler to perform yet apparently just as efficient as the more complicated procedures. With such a short proximal loop in the jejunum, an enteroenterostomy is unnecessary inasmuch as the length of the jejunum from Treitz's ligament to the upper end of the anastomosis is not more than the breadth of three of the surgeon's fingers. Rienhoff claims to have found the results from this procedure to be just as satisfactory as when more radical measures have been undertaken, while the mortality is decidedly less.

FACTORS IN MORTALITY

When we come to examine the causes of death following operations upon the stomach, as recorded in some of the more recent papers upon gastric and duodenal surgery, certain factors stand out with especial prominence. In the hands of a surgeon who is often called upon to intervene upon these regions or confines his efforts exclusively to this type of work, frequently the risk is not greater than in any other abdominal procedure, all other factors being equal. But in the general run of surgical procedures the country over, gastric surgery appears at the

head of the list of poor results. Not only is the mortality directly due to operation very high, but the postoperative morbidity
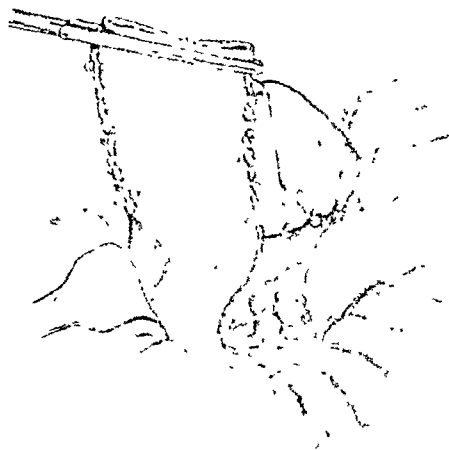
FIG. 2. Stomach held up at end of dissection with slight stretch upon the duodenum.

is much in excess of what it should be and the remote results are often unsatisfactory.

All these factors influence the attitude of the general public toward gastric surgery and make the average individual hesitate when he is informed that his condition requires an operation upon the stomach. This in a measure offsets the improved methods of clinical investigation which enable us to make the diagnosis so much earlier than was possible only a relatively short time ago, thus making the patients come late to operation and thereby preventing the surgeon from obtaining the results he might expect if he were permitted to handle the case more promptly. The vicious circle thus set up is very hard to break and constitutes what in business is called "sales resistance." It proves a very serious obstacle not only to the surgeon's success but to the patient's best interest as well.

TWO-STAGE OPERATION

In an attempt to reduce the mortality, we have at our clinic during several years past treated gastric and duodenal ulcer and cancer patients by a two-stage operation. For pyloric ulcer we first do a gastroenter-

ostomy, followed at the end of several weeks by resection of the ulcerous area. By this method we have found it possible, if necessary, to do a high posterior gastroenterostomy on doubtful or poor risk cases and so improve the patient's general physical condition. Within a short time, in most cases, he is able to withstand the actual removal of the ulcerous or cancerous area, which would undoubtedly have proved fatal if it had been undertaken at the outset.

The two-stage operation thus offers an excellent chance of success in cases in which the more radical procedures would not be feasible. Many patients have been relieved of peptic ulcer or even potential gastric cancer and have survived for years, usually dying in the end from some cause wholly unrelated to the stomach lesion. By doing this operation when the disease is still in a relatively early stage, we are able to conserve the patient's strength and so fit him for the strain of the actual resection. In this way our mortality has been reduced to less than 10 per cent as against the 60 per cent which Billroth sadly admitted in the later years of his professional career.

Lately we have been able to better these figures, for in the five years immediately past we have reduced the mortality in pyloric ulcer cases to less than 4 per cent. Proper postoperative attention will prevent recurrence in the form of gastrojejunal ulcer, which occurs much more frequently than published statistics would lead one to suppose. The surgeon should not consider his responsibility over when the patient leaves the operating room. On the contrary, ulcer of the stomach or duodenum must be looked upon as something more than a surgical problem. Only by carefully thought out co-operation between operator and internist can such postoperative care be efficiently administered.

If the internist has done his duty, the patient coming to operation will already have had a thorough physical overhauling; but it is surprising how often the surgeon finds that such precautions *before* operation

have not been considered necessary. Therefore, if existing foci of infection (such as teeth with apical ulcers, infected tonsils, diseased sinuses or gallbladders which have "given trouble" for long periods) have not been eliminated, it becomes the surgeon's duty to insist upon their prompt eradication.

The patient's habits should be a matter for thoughtful scrutiny. He should be taught the proper hygiene of the mouth—a matter surprisingly neglected even among the better class of patients. His diet should be investigated and a proper regimen laid out for him, if his eating habits are found to be contributing to the gastroduodenal condition. Patients with ulcers will usually have been upon a long course of "ulcer diet" previous to operation. This is by no means an ideal preparation for an exhausting surgical intervention; yet food restriction is, of course, absolutely essential in most of the cases. The immediate postoperative diet should, however, be modified as soon as possible, although such modification must be gradual and its effect upon the patient's general well being carefully checked at frequent intervals.

It has been the experience of our clinic that patients suffering from ulcers, quite as much as those suffering from diffuse toxic goiter, need psychological supervision as well as attention to their physical requirements. Not only should they have plenty of rest and careful avoidance of fatigue in any form, but they should also be freed from worry and excitement and urged to relax and enjoy life. It is frequently most difficult to effect such a regimen, for during the past few years few indeed have been the patients whose lives were not overshadowed by material cares—all too often by the shadow of actual want and privation. But the methods employed in our goiter work have served us well in ulcer cases and the importance of the mental, as opposed to the physical, disturbance which the sufferer from gastric lesions endures is recognized as being nearly equal to the physical handicaps.

In recommending the two-stage procedure, we do not wish to be understood as regarding it as universally applicable. When the patient is in good physical condition and not too greatly depleted as a result of his gastric lesion, so that he is considered a "good risk," the gastroenterostomy and the stomach resection can be carried out at a single session. If a high posterior gastroenterostomy is not considered desirable, we have substituted a high anterior loop anastomosis. We have also found that such an anastomosis need not necessarily be at the extreme distal portion of the stomach. In a number of patients in whom the anastomosis was made upon the high posterior wall, the stomach rapidly accommodated itself to the new arrangement and normal muscular movements were rapidly resumed, so that no gastric stasis occurred.

The resection of peptic ulcer is by no means so extensive an intervention as that required when one must deal with a malignant growth. Because glandular involvement is almost sure to be extensive, a far wider resection is imperative in cases of cancer. We must remove not only the malignant area in its entirety but also the zone of potential malignancy which surrounds it. Under such conditions we usually make a posterior anastomosis; but if circumstances seem to warrant it, an anastomosis in front of the colon may be substituted with safety. No hard and fast rule can be laid down. The surgeon must use his best judgment according to the requirements of the individual case.

The advantages of the two-stage procedure in cases of carcinoma of the pyloric end of the stomach in greatly depleted patients should be especially stressed. Another advantage of the high gastric resection in two stages in cases of gastric cancer has been pointed out by Wangensteen,[11] who noted that it obviates retraction of the esophagus, so often a troublesome feature of the single-stage intervention. This operator also believes that there is much less danger of contamination

when the preliminary gastroenterostomy is employed.

In cases of ulcer there is always the possi-

the area to be excised is removed from above downward. When following this procedure it is possible for us to visualize
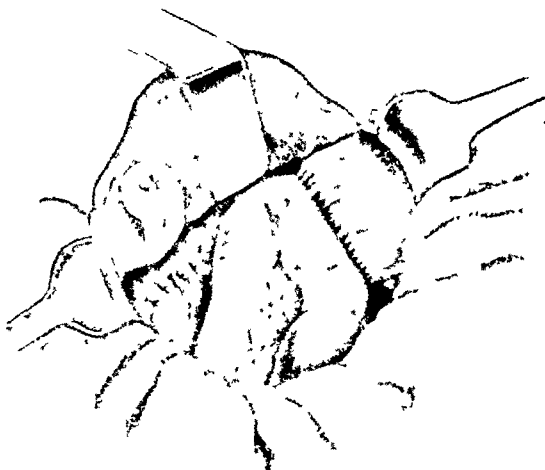
FIG. 3. Operation completed.

bility that resection may be avoided altogether when a supposedly preliminary gastroenterostomy is done. The ulcer will sometimes heal completely when the irritation of the passage of material impregnated with the digestive juices is eliminated. Schachner[12] has reported from the Mayo Clinic that 8,600 gastroenterostomies have been done, in many of which subsequent gastric resection was found to be unnecessary. In some instances the enterostomy and resection were carried out at one session. In general, however, the methods at this clinic are conservative; yet they report 90 per cent of cures in gastric ulcer and even lower mortality when the ulcer is located in the duodenum. Such results certainly point to the wisdom of less radical methods.

TECHNIC

After many years of experience and considerable cautious experimentation, we believe that we have now achieved a technic of stomach resection which, though much simpler than the methods formerly employed, gives us less difficulty as to both immediate and remote complications.

We now begin our resection at the upper or proximal portion of the stomach, so that

the posterior gastric wall all the time the resection is being done. This ability to visualize the entire field and even beyond it is a decided advantage, because one is much less likely to injure the pancreas or (in cases in which posterior adhesions have formed) to encounter troublesome hemorrhage.

As soon as the resection has been carried out to the desired limits, the proximal portion of the gastric wall is covered with a heated pad. The distal end is then raised, permitting the clamping and division of the gastrocolic and gastrohepatic omentum, which are carried out as the descent is accomplished. The posterior wall of the stomach is kept under constant supervision, a sharp lookout being maintained for any posterior adhesions. If adhesions are in evidence, they are divided as far down as the attachment of the pancreas to the duodenum. When this point is attained, it will be found an easy matter to strip off the attachment to the duodenum as far as may appear to be necessary. The duodenal arteries are divided and ligated, all hemostats are then tied and the duodenum is divided in the surgeon's usual manner.

Following this procedure, we carry out an anastomosis between the jejunum and

the stomach. As far as the writer is aware, this particular method has never before been described in print. It has the advantages of speed, accuracy and simplicity. In our hands it has proved preferable to the older methods we formerly employed.

CONCLUSIONS

1. Radical gastric surgery carries a high mortality. The history of gastric operations shows that there was at first a gradual advance from conservatism to more radical procedures, but that at the present time there is a decided trend away from radicalism and a very general tendency to revert to the earlier attitude in the hope that the death rate and postoperative morbidity may be lowered.

2. The poorest results are seen in the figures of general surgeons who do gastric surgery only occasionally and thus have no opportunity to acquire the skill and develop the judgment necessary for this work.

3. Careful preoperative check-ups on the patient's physical condition do much to lower the risks. Attention to diet and general hygiene after the operation will shorten convalescence, reduce morbidity and lower postoperative mortality.

4. The two-stage operation, consisting of gastroenterostomy followed after an interval by resection of the ulcerous or cancerous area, may be used with safety on patients too debilitated to withstand the complete operation at one session. In many cases of ulcer the preliminary gastroenterostomy has resulted in cure without the necessity of a subsequent resection. In those cases in which resection is essential, it can be carried out as a second stage without danger even when the patient is much debilitated at the outset, because the gastroenterostomy so greatly improves the patient's nutrition and general well-being.

5. The author has developed a new and simplified technic for performance of the one- or two-stage intervention which he believes has never before been published. It has proved in his hands to be a distinct improvement over methods previously employed in his clinic, both in immediate and remote results.

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THE DISTRIBUTION OF ANESTHESIA FOLLOWING BLOCK OF THE SACRAL NERVES

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CAUDAL and sacral block procedures have been found to give reliable and safe anesthesia. Yet, despite their frequent use, an important question concerning them has not been settled to the satisfaction of many. This concerns the indication, if any, for the choice of one procedure over the other.

At this institution the two procedures, from the practical viewpoint of producing anesthesia for the common rectal and perineal operations, are found to be interchangeable. Others hold that sacral block provides the only consistently satisfactory result. We are using our material, which in the past has averaged over 200 cases annually, to establish more definitely the relative merits of the two procedures. In a report in preparation the two procedures will be compared and contrasted in many ways.

Before proceeding with comparisons of the two blocks, a more fundamental subject had to be settled. This concerned the exact nature of the anesthesia on the trunk and lower limb that should be expected to follow interruption of sensory conduction at the posterior roots of the sacral nerves. This differs from a description of the anesthesia that follows the clinical procedures of sacral and caudal block. The former area represents a standard from which the clinical effect produced by the block procedures may be judged. We have been unable to find an attempt at an exact deliniation in reading a considerable part of the large literature.

The knowledge necessary to outline these areas has been available since the publication of Foerster's work on the dermatomes of the human body.[1] This work, as well as certain theoretical anatomical considerations, and clinical observations on sensory areas following block procedures have been brought together as the subject of this paper.

ANATOMICAL FACTORS CONCERNING THE SACRAL NERVES

A. Caudal and Sacral Block Distinguished by Example. Reference is made to caudal block and sacral block throughout. It becomes necessary then to emphasize that the technic of caudal block when performed alone differs from that done as part of the complete sacral block. More of the anesthetic solution is used and more time is taken for the injection.

The difference is brought out by the following example: Using 1 per cent of metycaine 60 to 70 cm. of solution are used in either procedure. In the sacral block, 25 to 30 cm. are injected into the caudal space; the remainder is divided for injection into the sacral foramina. In the simple caudal block the entire amount is injected slowly through the one puncture into the sacral canal. The needle is left in place and the injections continued until skin tests show that anesthesia in the desired area is present. This injection is deliberately prolonged over a period of twenty minutes to avoid a drug reaction.

The practical observation may be added here that saving time is not one of the advantages of the simplified caudal block over sacral block procedure. The recurring temptation it presents to attempt to do so during a crowded morning is its worst disadvantage.

B. Site of Block. Anatomical peculiarities of the tissues surrounding the sacral nerves have an important relationship to the block that results after injection is made by the caudal or transsacral route.

In each procedure the injected anesthetic drug acts upon the sacral nerves at approximately the same place. Yet the slight difference in the site of action is of considerable importance. In the caudal block the needle is advanced upward in the sacral canal and the solution is deposited around the termination of the dural sac. This is a true epidural injection. From there the solution disseminates outward along the nerves to and through the sacral foramina. It thus acts on the sacral nerves at the same place that direct injections through the sacral foramina would make contact with them, and probably over a considerably greater length of the nerve as well. There is evidence, however, that the anesthetic acts on the nerve only distal to any prolongation of the dural covering.[2]

By the time an individual sacral nerve comes to lie in its anterior and posterior foramina it has undergone its first subdivision into anterior and posterior rami. These subdivisions only are directly injected by the transsacral approach. The undivided sacral nerve and the ganglion of its posterior root lie within the sacrum where they are reached only by solutions diffusing through ·the epidural space. The sacral nerves and the rudimentary coccygeal nerves differ from all other spinal nerves (excluding the peculiarities of the first two cervical nerves) in that their ganglia do not lie within the intervertebral foramina.

C. The Relative Importance of Anterior and Posterior Rami of Sacral Nerves. Though the openings of both the anterior and posterior sacral foramina may frequently be pierced by a single injection and the needle point thus brought anterior to the sacrum or even within the pelvic cavity, this is not always so. The sacral foramina are not simple openings lying directly opposite each other on either side of the sacrum. The corresponding anterior

and posterior foramina are anatomically described as openings at the lateral ends of a V-shaped canal. This canal is open
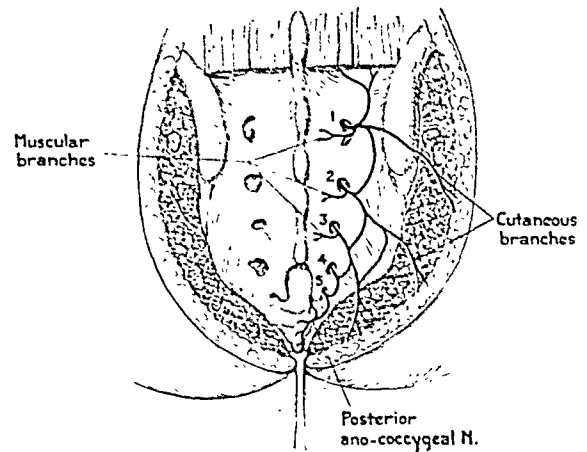
FIG. 1. The posterior sacral plexus. Simple loop connections exist between the nerves. Medial (muscular) branches supply the multifidus. Lateral (cutaneous) branches pierce the gluteus maximus and supply a limited area of integument. The posterior anococcygeal nerve formed by s 4 and 5 and co 1, is cutaneous in distribution and supplies the skin at the dorsal aspect of the coccyx.

medially, continuous with the sacral canal, and transmits the anterior and posterior rami of the sacral nerves to the openings of the foramina.

This arrangement has a bearing on the development of anesthesia after transsacral injection. It is the anterior rami that must be blocked for successful sensory anesthesia and muscular relaxation.

The relative unimportance of the nerves emerging from the posterior foramina is surprising on first consideration as the entire attention of the operator is centered on entering these foramina to produce transsacral block. Yet the posterior rami form a simple, looped plexus for innervating a relatively unimportant sensory area over the dorsocaudal region of the trunk and the buttocks. (Fig. 1.) The plexus supplies muscular branches to the multifidus and, joining at the lower end of the sacrum with the first coccygeal nerve, forms the posterior anococcygeal nerve. This is the rudimentary superior caudal trunk of tailed animals and supplies the skin over the dorsal aspect of the coccyx.

On the other hand, the ventral aspect of the coccyx and part of the region between it and the posterior border of the anus is supplied by the anterior anococcygeal nerve. This nerve is formed from the anterior rami of the lower two sacral nerves emerging from the anterior surface of the sacrum, and the coccygeal nerve. It is the rudimentary, inferior caudal trunk of tailed animals. Thus in the area extending from the ventral aspect of the coccyx forward, including the integument between the coccyx and posterior border of the anus, anal margin and all important muscles, the nerve supply, both cutaneous and muscular, stems from the anterior rami of the sacral nerves.

D. The Relationship to the Epidural Space. The sacral canal is part of the epidural space which runs the length of the vertebral column. Injections into it of anesthetic drugs during the performance of caudal block are capable of blocking not only the sacral nerves but also nerves coming off from any level of the spinal dural sac, depending upon the extent of the upward diffusion.

Upward diffusion in effective concentration is usually not extensive and only occasionally produces anesthesia as high as the inguinal region or, as in one of our cases, to the nipple line. This fails to occur regularly to an appreciable extent because lateral diffusion through the foramina of the sacrum presents less resistance.

Diffusion outward along the nerve trunks from the epidural space has been shown to progress freely both by the method of dissection following dye injection as well as by radiographic study after the injection of opaque material. In general, the dye solutions show a greater tendency for upward diffusion. They are found readily in the high cervical and thoracic regions, following injection of 30 cm. into the sacral and caudal space.[3][4] On the other hand, opaque material traced by roentgenograms on living subjects[5] and on cadavers[2][6] shows a greater tendency toward lateral diffusion along the nerve trunks.

Understanding of the behavior of solutions injected into the epidural space is aided by a brief consideration of the dura mater. The cranial and spinal dura, though continuous at the foramen magnum, are quite different. The cranial dura consists of two distinct layers which at certain places enclose the venous blood sinuses. The outer layer is closely attached to the bones of the skull and serves as a periosteal lining. After passing out of the skull and on to the spinal medulla at the foramen magnum, only the inner layer of dura is continued as a covering of the spinal cord. The outer layer of dura is soon dissipated and fails to continue as a lining of the vertebral canal except for a short distance anteriorly. Thus the spinal epidural space lacks an uninterrupted lateral wall. Diffusion of injected material is not greatly impeded in the lateral direction at the intervertebral foramina because the nerves pass through without acquiring a covering from the lateral border of the epidural space.

In considering the dura and epidural space in this light it is interesting that the relatively large veins frequently encountered during injections are in the same morphological plane as the cranial venous blood sinuses.

SENSORY AREAS SUPPLIED BY THE SACRAL NERVES

It is not easy to understand the area of anesthesia which develops in the lower part of the trunk and the limbs following interruption of the posterior roots of the sacral nerves nor can a simplified explanation be devised. In fact, without knowledge of the developmental history of the limbs and caudal region of the trunk, the problem becomes quite unintelligible.

A. Sensory Areas of Lower Part of Trunk. Confusion here is caused by the presence of (1) the small overlapping area of upper lumbar innervation upon the primarily sacrally innervated perineum and (2) in the male by the presence of the testicle, an aberrant viscus which retains at least some

of the innervation characteristic of other intra-abdominal organs.

1. *The Sacral Origin of Perineal Sensory*
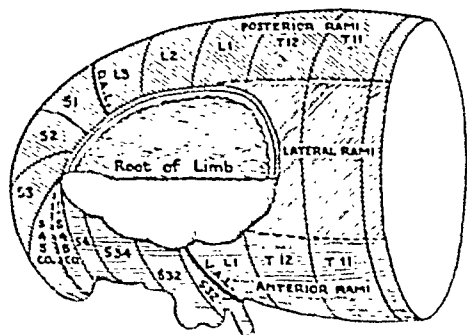
Fig. 2. Relationship of limb bud to the lower myotomes. The perineum develops mostly caudal to the limb. The dorsal (d.a.l.) and ventral (v.a.l.) axial lines are shown at their origins. They extend outward on the limbs and pass between adjacent dermal areas not innervated in numerical sequences. The interruption of segmental innervation at the ventral midline of the lower trunk as a result of the limb development is shown. (After Cunningham.[15])

Innervation. The outgrowth and subsequent development of the lower limb bud from the trunk during embryonic life profoundly alters the segmental arrangement of the lower trunk. In the development of the body, however, the perineum is readily seen to originate caudal to the limb bud. (Fig. 2.) As a result of the developing limb taking a large part of the adjacent nerve supply into its structure, the ventral midline of the body which is ordinarily supplied by the anterior terminal branches of the anterior rami of the segmental nerves, is not reached by these nerves between the segments L 1 and S 2. (Fig. 2.) Yet the ventral axis of the body receives adequate innervation as a result of nerves from the more caudal myotomes below the limb (s 2 through co 1) reaching to the anterior midline.

In the lower midventral axis of the body then, the structures occurring in sequence are (a) the lower part of the abdominal wall supplied by T 11 and 12, (b) the area of symphysis pubes supplied by T 12 and L 1, and (c) the penis and scrotum (mons and vulva). Part of nerve L 1 (ilio-inguinal)

innervates this latter area, but further lumbar elements fail to attain the ventral midline, being drawn into the developing
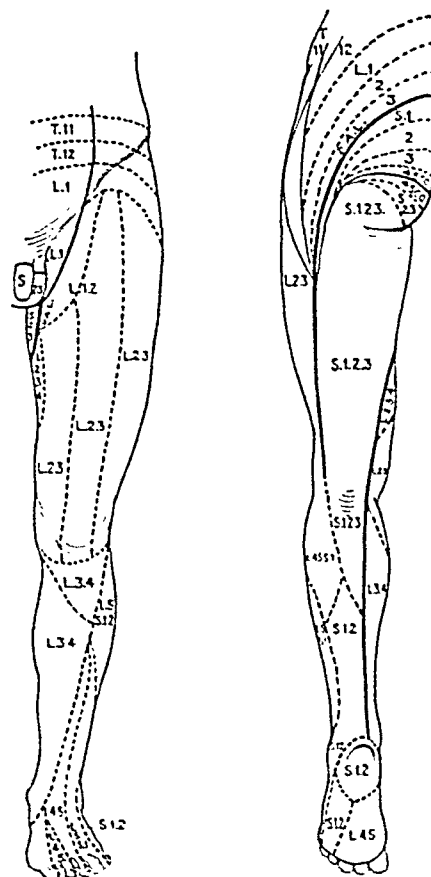
Fig. 3. The dermatomes of the leg outlined by anatomical methods. Areas are smaller than those outlined by "remaining sensibility." Compare L 5 here and in Figure 4. The hypothetical dorsal axial line (which ends near the knee) and ventral axial line are shown. The preaxial (cephalic) border of the limb extends from the middle of the inguinal ligament distally along the line of the great saphenous vein to the medial side of the great toe. The postaxial (caudal) border extends from the coccyx across the medial part of the buttock and down the posteromedial aspect of the thigh to the small saphenous vein. It follows approximately along this structure to the lateral side foot. The sequence of dermatomes can be followed first distally along the pre-axial border then proximally along the postaxial border.

limb. The orderly segmental arrangement of innervation is resumed, however, after the second sacral nerve reaches the ventral

axis at the region where the first lumbar left off.

This numerical gap in innervation, caused by the failure of certain sensory nerves to reach the surface of the trunk, and making for adjacent skin areas innervated from considerably separated cord levels, forms the basis of the hypothetical axial lines (dorsal and ventral). These lines are formed on the trunk and are carried down onto the limbs on dorsal and ventral surfaces. (Figs. 2 and 3.) Together with a knowledge of the embryonic pre-axial and postaxial borders of the limbs (Fig. 3), they give the principal clue of the segmental innervation of skin areas on the limbs (as will be described) and at the limb-trunk borders. Otherwise the arrangement of dermatomes in these areas appears to possess no more order than the covering on a patchwork quilt.

The second and third sacral nerves reach the midline of the trunk below the limb bud and provide the main sensory supply of the genitalia.

(d) The remaining structures of the ventral axis below the scrotum are the central point of the perineum, the anus, ischiorectal fossae and the coccyx. These areas are innervated in an orderly way by the anterior terminal branches of the anterior rami of the lower sacral and coccygeal nerves.

2. *The Innervation of the Testis.* The presence of the testicle within the scrotum further complicates the sensory innervation of the perineum. To the dual (sacral and lumbar) sensory innervation of the scrotum, as previously described, is added a thoracic connection, at least to its underlying structure, the testis. This afferent sympathetic connection originates at the T 10 level and is carried down along with the internal spermatic (testicular) artery as the vessel follows the viscus in its descent.

This triple level, sensory nerve supply of the testis and the overlying scrotum has been established beyond question by the work of Woolard and Carmichael.[7] They performed convincing experiments, using themselves as subjects. Among other things they showed that the pain threshold for the lumbar part of the innervation of the region of the testicle was approximately twice as high as that of the sacral innervation and that the threshold for perception of pain along the thoracic connection was approximately three times as high as for the sacral level. This gives further evidence that the primary source of innervation of these areas is sacral.

3. *Clinical Application.* The material thus far enables us to understand the clinical applicability of block of the sacral nerves for anesthesia of the lower trunk. For instance, circumcision in the adult is readily performed. An operation at the base of the penis such as correction of hypospadias might be unsuccessful. For operations involving the scrotum or testicle additional block of the genitofemoral, ilioinguinal nerves, or fibers accompanying the testicular artery might be necessary. All other structures at the caudal end of the trunk are readily rendered insensible by sacral nerve block and the muscles of the perineum, including the important levator ani and anal sphincter, are deprived of tone.

The anesthesia developing after sacral and caudal block is particularly suited for performing the operation of circumcision on the adult. The dual innervation at the base, of greater theoretical than practical importance, does not interfere with the anesthesia of the operative field. Furthermore, the block usually inhibits the ability to produce erection for many days. This result is probably related to a temporary nerve injury resulting from trauma by the needle at the site of the sacral autonomic outflow (anterior ramus s 2–3), and although subject to an unfavorable interpretation, produces a fortunate temporary result.

B. Sensory Areas of Leg. This subject is difficult to describe and understand because of (1) the loss of an obvious segmental arrangement of the dermatomes of the leg[s] and (2) the marked overlap of one

dermatome into the area of two or three adjacent ones. In this condensed presentation extensive elisions are necessary.

Areas of sensation

Fig. 4. Full extent of fifth lumbar dermatome. (After Foerster.) The remainder of the leg, except the area of anesthesia shown in Figure 5, is supplied by other lumbar nerves. Impaired sensation in the l. 5 area is positive evidence of effective cephalad diffusion in the epidural space. Marked areas in Figures 4, 5, 6 and 7 show tactile sensibility rather than pain sensibility. This makes fields slightly larger when areas of remaining sensation are shown and slightly smaller when areas of anesthesia are outlined.

1. *Segmental Arrangement of Dermal Innervation on the Limb.* The orderly segmental arrangement of the myotomes concerned with the development of the limbs is probably preserved within the limbs only in the arrangement of the somatic nerves and then in a manner far from obvious. As these nerves grow into the limb they maintain a fairly orderly succession along the pre-axial and postaxial borders. The higher nerves, after division into anterior and posterior trunks, supply the pre-axial border of the respective anterior and posterior surfaces of the limb in numerical sequence from the proximal to the distal border. The numerical sequence is maintained along the distal border of the limb toward the postaxial border, and then along the postaxial border from the distal to the proximal end. The lowest nerves entering the limb, for example, supply the most proximal part of the limb along the upper part of the postaxial border. (Fig. 3.) It is thus seen that a simple arrangement, whereby the higher nerves would

supply the proximal part of the extremity and the lower nerves the distal part, does not prevail.
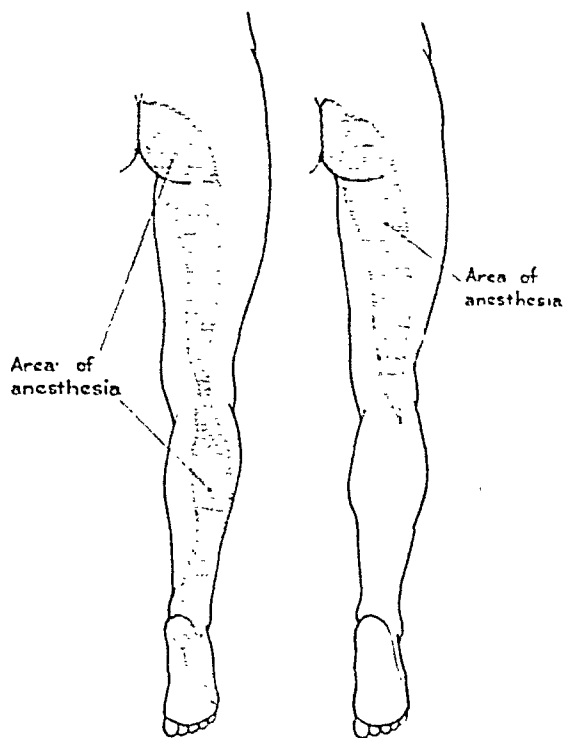
Fig. 5.   Fig. 6.

Fig. 5. The area of anesthesia on the thigh and leg following interruption of all five posterior sacral roots. (According to Foerster.)

Fig. 6. The complete area of anesthesia on the lower extremity following interruption of the posterior nerve roots of s 2 and 5. The usual clinical block aims at blocking the anterior and posterior rami of these nerves.

Understanding the sensory areas on the leg is complicated further by the fact that the pre-axial and postaxial borders (these terms mean simply the proximal and distal borders of the embryonic limb bud and their subsequent development) achieve a much altered position in the adult from the simple arrangement existing in the fetus. This occurs through the rotation of the limb in development, and is compounded by the fact that the upper limb and the lower limb on each side rotate in opposite directions. In the lower limb the embryonic ventral surface becomes practically the mature dorsal surface.

In the preceding discussion of the perineum the origin of the hypothetical dorsal and ventral axial lines was mentioned. (Figs. 2 and 3.) It was related to the failure

of certain of the centrally placed nerves entering the root of the limb to attain the surface of the limb, (in the former instance the surface of the trunk) leaving a line

They are shown to follow a roughly circumferential course about the limb from the upper pre-axial to the upper postaxial borders.

Area of anesthesia

Area of sensation

A   B
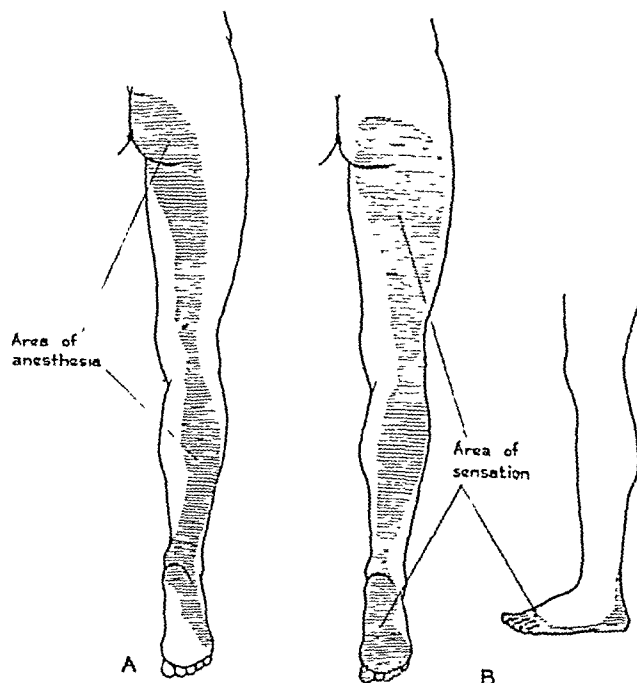
FIG. 7. Area of insensibility (A) after interruption of posterior roots of all five sacral nerves contrasted with area of remaining sensibility (B) of a single one of them, s 2. The former is smaller. Small differences exist at the proximal and distal ends of the fields shown. (According to Foerster.)

along the approximate midpart of each embryonic ventral and dorsal surface where adjacent areas of the skin are innervated by nerves not in strict numerical sequence. (Figs. 2 and 3.)

After consideration of the pre-axial and postaxial borders of the limbs (described in the legend to Figure 3) and the hypothetical dorsal and ventral axial lines (Figs. 2 and 3), we are in a position to interpret the usual picture of the dermatomes as given in most treatises on anatomy and to appreciate the recondite, nevertheless orderly, arrangement that is preserved. These pictures, such as Figure 3, present the outlines of dermatomes as worked out originally by Head[9,10] before 1893 and subsequently modified by anatomical methods.

The area marked as belonging to an individual dermatome represents the approximate central part of each dermatome.

2. *The Overlap of Dermatomes.* As the area of sensation referred into the cord through each spinal nerve is actually much larger than shown, these outlines have little practical value.

However, considerable exact knowledge concerning the dermal areas on the lower limb does exist as the result of the work of Foerster.[1] He has had the opportunity of defining almost every dermatome on human subjects by Sherrington's method of remaining sensibility.[8,11] This term refers to the area of sensation left after division of the three posterior roots above and below the one being studied. (In sacral anesthesia it is not the posterior roots but the combined anterior and posterior rami that are blocked.)

Foerster's method obviously gives the full extent of each dermatome including the overlap onto the adjacent ones.

Using these enlarged outlines of dermatomes, certain figures can be prepared for showing the exact area of sensation loss on the leg to be expected following interruption of the posterior sacral roots. The efficiency of anesthetic blocks may be determined by comparison.

The significance of these areas (Figs. 4, 5, 6 and 7) in relation to clinical block procedures is given in the legends to the figures and in the discussion.

DISCUSSION

There is no loss of sensation in a given spot on the skin where complete sensory nerve interruption to two of the three dermatomes supplying the area has occurred but where the nerve supply to a third dermatome remains intact. More than this, several investigators have shown on animals and Foerster[12] has shown on human subjects, that the entire dermatome is represented in every filament of the posterior root. If one filament remains intact, no anesthesia develops in the entire dermatome.

This fact helps to explain the difficulty and uncertainty in producing block anesthesia which depends for its successful accomplishment on diffusion over considerable distance after the injection has been made. Brachial plexus block, or else the type of epidural block under consideration here, when deliberate upward diffusion for high anesthesia is sought, present examples of this difficulty.

By making use of exact dermal areas of innervation the one practical means of tracing effective upward diffusion in the epidural space following caudal and transsacral block is available. Other methods that have been used have limitations. Dye injections are of academic interest only. Contrast media show the physical progress of the diffusion without establishing whether the quantity is effective in producing anesthesia. On the other hand the area of anesthesia achieved, provided interpretation of its relationship to the cord level is available, localizes exactly the extent of effective diffusion.

As effective diffusion progresses upward in the epidural space, the course should be shown by sensory changes on the limb. From a small area on the back of the thigh, showing involvement of s 2–s 5 (Fig. 6), anesthesia should progress to the back of the leg and heel, showing involvement of s 1 (Fig. 5), thence to the great toe (L 4 through s 5), and the knee (L 2 through s 5).

The actual development of anesthesia on the leg after clinical block of the lower four sacral nerves closely follows the pattern indicated by accurately limited posterior root sections. However, the progress of the anesthesia is often irregular and subject to the changes of intensity over many minutes. The anesthesia spreads from the anal margin distally, along the medial aspect of the buttock, toward the center of the posterior surface of the thigh, stopping well above the leg. (Fig. 6.) Frequently, however, full sensibility is preserved in this area after the sphincter has completely relaxed. This condition is usually followed by loss of pain and finally by tactile sensibility on the area as shown.

Ten minutes later and even longer, the heel becomes insensitive. (Fig. 5.) This indicates positive cephalad diffusion in the epidural space. The first sacral nerve, which must be blocked to produce anesthesia of the heel, comes off at a level definitely beyond the immediate vicinity of the extremity of the needle used for injection.

In the areas that positively depend upon effective diffusion for the development of anesthesia, touch sensibility is preserved long after pain sensibility has gone. On pinpoint testing the lightest touch is appreciated immediately. This condition prevails for many minutes. At first it prevented realization of the fact that sensory changes were taking place. Later it was found that a sterile needle could be skewered through the skin where tactile sensibility remained without causing pain perception. Finally, complete loss of sensation develops.

In Foerster's work with sectioned posterior roots the area of remaining sensibility was found to be larger for touch sensibility than for pain. From the above observation apparently the tactile fibers, beside covering a larger area than pain fibers, resist, to a greater extent, the action of anesthetic drugs.

When large quantities (100 cc. of a 1 per cent solution of metycaine) are given slowly, diffusion progresses for as long as forty-five minutes. At the completion of a rectal operation, for instance, the great toe and even the entire lumbar innervated area on the anterior surface of the leg and thigh, may have lost pain sensibility, whereas it preserved full sensation before the operation was started.

The higher lumbar areas, when affected at all, seem to give up sensation simultaneously as though upward diffusion had occurred over a considerable area rapidly, but effective penetration of the nerves by the solution had been delayed. Usually only pain sensibility is lost at these higher levels.

These effects on the lumbar nerves usually follow the use of caudal block alone and in the relatively large quantities mentioned. After smaller amounts in both caudal and sacral block frequently nothing but loss of pain sensibility with tactile sensibility preserved is found on the legs in the region indicated in Figure 6.

CONCLUSIONS

Anatomical material, related both to the development and ramification of the sacral nerves and the anesthesia that should be expected after these nerves are interrupted, has been brought together. The areas of anesthesia to be expected on the caudal part of the trunk and on the lower extremity have been described.

Clinical evidence of the course of effective upward diffusion of anesthetic solutions injected into the epidural space has been presented. As higher nerves become involved the area of sensation loss on the leg shows an orderly progression. It passes from the back of the thigh downward to the back of the leg and heel, thence to the big toe, upward to the anterior surface of the knee and finally reaches the inguinal region.

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AN ANALYSIS OF 151 CASES OF INTUSSUSCEPTION FROM CHARITY HOSPITAL OF LOUISIANA AT NEW ORLEANS*

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NEW ORLEANS, LOUISIANA

THE subject of intussusception in infancy and childhood was so comprehensively discussed by Ladd and Gross[1] in 1934 that an extended review of the literature would not be necessary or even justified at this time. On the other hand, although their analysis of 372 cases is one of the largest collected series on record, analyses of similar series continue to be justified, for the mortality of the condition, except in the hands of occasional surgeons who have personally seen large series, continues to be unduly high.

During the thirty-four-year period ending in 1938, 151 patients with intussusception were treated at Charity Hospital of Louisiana in New Orleans, twenty-one in the first decade, thirty-three in the second, seventy in the third and twenty-seven in the last four years. Since many of the cases in the first years were diagnosed only at autopsy, it may be assumed that many other cases were overlooked during that period, and the increasing incidence, as the study progresses, is perhaps largely apparent. On the other hand, the unevenness of the recent incidence is difficult to explain. There seems no reason why eleven cases should have been observed in 1933 and twelve in 1937 against three in 1935 and five in 1938.

RACE, SEX AND AGE INCIDENCE

In the 148 cases of this series in which the race was stated, eighty patients were white and sixty-eight negro. This is a relative incidence of 54:46, which is approximately the white-negro incidence of admissions in an average year at the New Orleans Charity Hospital.

The sex incidence is essentially the same as reported in other series, ninety-eight of the 151 cases occurring in males, against fifty-three in females. This proportion, 64:36, is approximately the same as that reported by Ladd and Gross, Hipsley,[2] McLaughlin,[3] and Miller and Workman.[4] Almost the only series in which the female incidence is even slightly greater than the male is that of Davis,[5] which consists of only twenty-two cases.

In the Charity Hospital series eighty-eight cases (59.5 per cent) occurred in children under two years of age, thirty-two cases (21.6 per cent) in individuals between two and fifteen years of age, and twenty-eight cases (18.9 per cent) in individuals sixteen years of age or older. The age was not stated in three cases. The upper and lower age limits were two months and sixty-three years.

Fifty-one patients under two years of age were white and thirty-six negro; from two to fifteen years of age, nineteen were white and fourteen negro; over fifteen years of age, ten were white and eighteen negro. The incidence of the adult type of intussusception is thus somewhat greater in the colored race, though the ratio is reversed in the infantile group. The differences are too small to permit conclusions, especially as the literature contains practically no data on the racial aspects of intussusception.

Intussusception is predominantly a disease of extreme youth. Of the eighty-eight cases in this series, representing consider-

ably more than half of the whole group, which occurred in children under two years of age, seventy-three, roughly 83 per cent of this group and almost 50 per cent of the whole group, occurred in children under one year of age. Furthermore, forty-one cases, roughly 56 per cent of the group under one year of age and roughly 28 per cent of the whole series, occurred in the fifth, sixth and seventh months of life.

These figures parallel those reported in the literature. Eighty-seven per cent of Ladd and Gross' cases occurred under two years of age, and 70 per cent in infants between four and eleven months. Mayo and Phillips[6] reported 80 per cent, Perrin and Lindsay[7] 78.5 per cent, Rosenblum[8] 75 per cent, Davis 59 per cent, Miller and Workman 54 per cent, and Straus[9] 60 per cent in the same age period. Only five cases in the Charity Hospital series occurred in infants under twelve weeks of age, and it is generally agreed that intussusception is not usual before this time.

<h3>ETIOLOGY</h3>

An analysis of this series throws no light upon the etiology of intussusception except to make clear again that from this standpoint the infantile and adult types are widely different. In the adult type it is fairly usual and in the infantile type it is definitely unusual to find a causative factor.

In this series Meckel's diverticulum was present in two of the eighty-eight cases in children under two years of age, and in a third a definite mass, probably of neoplastic origin, was observed in the cecum. In the thirty-two cases between two and fifteen years of age, three patients presented Meckel's diverticula, two polyps and one a fibrosarcoma of the intestine. In the twenty-eight cases over fifteen years of age, Meckel's diverticulum was present in one case and neoplastic growths, two of which were malignant, in six others. The relatively high incidence of new growths in the older age groups corroborates the general belief that they are characteristic of

adult intussusception. They were observed in 100 of the 300 cases collected by Eliot and Corscaden (cited by Christopher[10]). The infrequency of a causative factor in the infant group, on the other hand, is generally corroborated in the literature; Ladd and Gross found a cause for the accident in only 5 per cent of their cases.

An indefinite or remote cause, such as diarrhea, enteritis, enlarged mesenteric glands, dietary indiscretions, enlarged Peyer's patches, adhesions, constipation, or the taking of a purgative, was present in twenty-two cases, alone or in combination, in the infantile group, in ten cases in the middle group, and in eight cases in the adult group. There is considerable reason, however, to question the cause and effect relationship. Thus diarrhea and constipation are quite as likely to be results as causes of the intussusception, the former early in the process and the latter at a later stage. Rosenblum suggested the marked peristalsis concomitant with diarrhea, which was present in 5 per cent of his cases, as a possible cause. The frequent occurrence of enlarged mesenteric glands and mobile cecums in the infantile group is rather striking, but how such conditions could operate to produce intussusception is not clear.

Dietary errors have been mentioned as a possible cause, particularly among patients of the poorer classes; but Ladd and Gross, whose series includes a large number of private patients, do not consider the suggestion reasonable. Hipsley noted a somewhat higher incidence (158) in the hot months as compared with the cold months (151), and it is striking in our own series that eighty-six cases, well over half of the total number, occurred in the five-month period April to August inclusive, when diarrhea is commonest in children.

None of the other causes suggested, most of which are purely speculative, were observed in the Charity Hospital series, and heredity seemed to play no part. In this connection, one must mention the interesting case reported by Haggard and Floyd,[11]

in which a father and his daughter each had two resections for intussusception, while the son had one disinvagination and three resections for the same condition. Also of interest are the two cases reported by Fiske[12] following prolonged fasting in the observance of Mohammedan religious rites.

CLASSIFICATION

In addition to the obvious division into primary and adult types, intussusception is classified regionally, according to the section of bowel in which it occurs, and also as single or multiple. The common anatomic types are the ileoileal or enteric and the colocolic, which are self-explanatory; the ileocecal, which occurs if the intussuscipiens, when it reaches the ileocecal valve, meets some obstruction and carries the valve ahead with it as the apex of the intussusceptum; and the ileocolic, which occurs when the ileum passes into the large bowel through the ileocecal valve.

As in all series, the ileocecal and ileocolic types were most frequent in the Charity Hospital cases, although most surgeons, unfortunately, made no distinction between them. They accounted for a total of seventy-seven cases, (fifty-two in the infantile, fifteen in the intermediate, and ten in the adult group). The enteric type of intussusception was present in nineteen cases (seven infantile, three intermediate and nine adult), and the colocolic type in eleven (three infantile, five intermediate and three adult). The various types were fairly evenly distributed between colored and white subjects.

Multiple intussusception occurred in three cases, two in the infantile and one in the adult group. In one case three enteric (ileal) invaginations were found, all of which were easily reduced. In a second case seven were found, one of the ileocecal and six of the enteric type; each was about 5 cm. in length, and reduction was easily effected in all. In the third case a colocolic invagination was easily reduced, but the ileocecal invagination also present caused considerably more difficulty. In a fourth

case two enteric (jejunal) intussusceptions, about 25 cm. apart, were discovered at autopsy and may have been a postmortem phenomenon. The multiple type of invagination is apparently not very frequent. It was observed in only three of Ladd and Gross' 372 cases, and single cases have recently been reported by Kander,[13] Gill[14] and Papodopoulous.[15]

What seemed to be a double intussusception was found in one case in this series, the ileocolic invagination passing into the descending and sigmoid colon. Another case described as double seems more likely to have been merely of the ileocecal variety. Double invaginations have been reported by Engstad[16] and by Dwan and Wyatt.[17]

Retrograde intussusception occurred in only one case in this series, an infant twenty-one months of age, in whom the lower ileum was found at operation to have invaginated six to seven feet upward into itself. According to Rosenblum, this type occurs most frequently just before or at the time of death. Single cases have been reported by Mitchell,[18] Lewis,[19] Flemming[20] and Ryan.[21]

It is possible, as happened in one case in this series and in one reported by Hipsley, for the ileum to pass through the entire length of large bowel and present at the anus. The colocolic type of intussusception may also present at the anus and on superficial inspection may resemble a prolapse, though differentiation is simple on rectal examination.

One case of intussusception of the cecum in which the appendix was involved is included in this series, and partial appendiceal intussusception is undoubtedly more frequent than the eighty odd cases reported in the literature would seem to indicate. I myself have knowledge of two other cases at Charity Hospital which are not included in this analysis.

It is regrettable that in thirty-nine cases in this series, twenty-seven infantile, six intermediate and six adult, an adequate classification of the intussusception was not possible.

RECURRENT INTUSSUSCEPTION

Recurrent intussusception was actually or presumably present in fourteen cases, three in the infantile, four in the intermediate and seven in the adult type. Since the frequency of intussusception in the three groups was respectively 88, 32, and 28, the distribution of the recurrent cases is significant, and is undoubtedly to be explained by the increased frequency of neoplastic causes in the intermediate and adult groups.

The distribution of the deaths in the recurrent cases is also interesting. One death occurred in the three patients in the infantile group, none in the four cases in the intermediate group, and two in the seven cases in the adult group. An examination of the individual records reveals in several cases in the intermediate and adult groups a history of severe episodes over a period of months, and makes one wonder how the patients escaped with their lives. In several cases in this series, for that matter, symptoms were present over so long a period of time that the condition could probably be classified as chronic. The histories suggested that the invagination had been present one or more times, reducing itself before symptoms were sufficiently acute to force the patient into the hospital and being succeeded by a period of quiescence.

In one of the recurrent cases in the infant group the intussusception either recurred within six hours or reduction at operation was incomplete, for postmortem examination six hours after death showed an intussusception of the entire large intestine. The same question arose in another instance in which death occurred three days after operation.

A possible recurrence was suspected but not proved in two other cases, both in the intermediate group. One patient had a return of symptoms, which disappeared under conservative therapy, within a week after operation. The other, an eight-year-old girl, whose intussusception was reduced surgically, had a clear-cut history of a similar attack, from which she had recovered without operation, at eighteen months of age.

SYMPTOMATOLOGY

An examination of the symptomatology and physical findings in this group of cases revealed a very high correspondence with the classical picture: A perfectly well child, frequently a male under two years of age, had a sudden attack of acute abdominal pain manifested by crying, the assumption of a certain posture, or even the placing of the hands on the presumably painful area. The pain was frequently associated with vomiting and bloody stools. It was the exception rather than the rule to find any mention of emaciation or other signs of previous illness in these children, even those who were gravely ill from the result of their obstruction. Pallor and sweating accompanied the pain in some instances, but the temperature tended to be normal or subnormal and the pulse relatively slow unless shock, dehydration or peritonitis was associated with an obstruction of relatively long duration.

This series emphasizes again the importance of remembering that in the typical case of intussusception symptoms are present only spasmodically, and that the child may seem perfectly well between attacks. In three instances in this series the children were seen in the admitting room between attacks, the gravity of the situation was not realized, probably because the parents' histories were inadequate, as it so often is in individuals of this level of intelligence, and the patients were sent home as not seriously ill. All returned, of course, at a later period and in a far more serious condition. It should also be remembered, in this connection, that although bloody stools are very frequent in intussusception, the first stool is often normal because it consists of fecal matter contained in the rectum.

An abdominal mass, which is part of the typical picture of intussusception, was

present in a large majority of these cases, though in some instances it was identified only by rectal examination or after the patient was under an anesthetic. One of the notable features of the histories was the persistence of the term "sausage-shaped" for the masses over the whole thirty-three years. Whether the resemblance actually impressed the various historians, or was merely handed down, as such terms frequently are, from one generation of medical men to the next, is an interesting source of speculation.

The masses were variously located in the midline, the right and left upper and lower quadrants, the epigastrium, the lower abdomen and the paraumbilical and umbilical regions. Dance's sign, emptiness of the right lower quadrant, was observed in one instance.

DIAGNOSIS

The diagnosis of intussusception was confirmed at operation in 121 of the 151 cases and by autopsy in fifteen others. In three of the latter group the postmortem examination was performed in the coroner's office. In three instances in which operation was not done, diagnosis was made on definite radiologic evidence, and in the remaining twelve nonsurgical cases the history and physical findings were sufficiently definite to leave little doubt as to the correctness of the diagnosis.

Intussusception at Charity Hospital was first diagnosed by x-ray accidentally in 1920, in a case in which a KUB film was made. Flat plates were used occasionally thereafter until 1929, when the use of a barium enema for this purpose was first recorded. This method was used in thirty-one of the sixty-five cases observed after 1930. The film was reported negative in three of these cases, and in two others the diagnosis was ovarian cyst and lymphosarcoma. The findings did not differ from those usually reported.

A study of the records makes it clear that radiographic examination with the barium enema was occasionally very useful in diagnosis, though it was unnecessary in the great majority of cases, in which the history and physical findings were typical. Fluoroscopy was sometimes an important aid. Reports in the literature differ as to the value and necessity of this method. Edberg (cited by Rutledge[22]) is more positive than most authors as to its value, asserting that it makes possible differentiation between the rather easily reduced ileocecal obstruction, which can sometimes be treated by conservative hydrostatic methods, and the stubborner ileoileal and colocolic types, in which surgery is practically always necessary.

CONSERVATIVE THERAPY

Conservative therapy was not used deliberately in any case in this series. The Charity Hospital surgeons seem to share the general opinion that gambling on so remote a possibility as spontaneous cure can scarcely be described as a method of treatment. The type of case in which the intussuscipiens sloughs out after its blood supply is damaged, and intestinal continuity is later restored by natural processes (Bockhoven[23]), does not seem to be included in the Charity Hospital series.

Although the method was not deliberately employed in any case in this series, reduction of the invagination by hydrostatic pressure has been so very successful in the hands of Hipsley that it cannot be ignored. The method, as he used it, seems both safe and successful, and the number of accidental reductions reported after barium enemas makes it seem perfectly logical. It will have to be used more widely, however, before generalizations concerning it are possible.

SURGICAL THERAPY

Surgery was employed in 121 cases in the Charity Hospital series, in 116 of which it was possible to determine exactly what was done. The general plan seems to have been to regard intussusception as a strictly surgical condition and to resort to operation as soon as the diagnosis was made. The

cases handled in the later years of this study were almost invariably treated in this manner unless the patient refused surgery.

Reduction was accomplished by simply milking back the intussusception in eighty-three of the 116 cases (68.6 per cent) with a mortality of thirty-two cases, 38.5 per cent. Some degree of traction was usually necessary and warm packs were usually applied. Ladd and Gross used this method in 83 per cent (308) of their 372 cases, with a mortality of 27 per cent for the first twenty years and of 12 per cent in the last five years. The *discrepancy between their series and ours* is somewhat less than it seems because their series includes a fairly large number of private patients, the mortality of whom in *acute conditions is usually less than that of* ward patients.

Incision of the cuff was used in two cases, and two others were treated by anastomosis around the mass, leaving the intussusception to slough out. All four patients died, one child dying on the table before the operation was complete.

Resection was done in twenty-seven cases, the type undoubtedly playing an important part in the mortality rate. In this series fifteen resections followed by anastomosis resulted in nine deaths, two of which occurred in the seven end-to-end anastomoses and four in the seven side-to-side anastomoses. There were four deaths in the seven resections in which the type of anastomosis could not be determined. These figures leave no doubt that anastomosis in the presence of intussusception carries as high a death rate as it does in any other type of intestinal obstruction.

Counting all operative cases, enterostomy was performed eleven times, twice after reduction, with recovery in both instances, and nine times after resection, with five deaths. There was one death in the two resections in which double-barreled enterostomy was performed. The one case in which resection was done as the second stage of exteriorization of the bowel ended in recovery. Woodhall[24] has reported two

successful resections by a modification of the usual Mikulicz procedure to include a lateral anastomosis below the openings of the double-barreled enterostomy. He considers that this modification, in addition to guaranteeing the immediate continuity of the lumen of the bowel, is of value in *controlling the obstruction due to edema* which frequently occurs at the site of the anastomosis, as well as in controlling the fluid loss. In view of the high mortality of immediate anastomosis following resection in cases of obstruction, the double enterostomy would seem, in general, to be a logical procedure.

Six of the resections were performed in infants with six deaths, nine in subjects in the intermediate group with four deaths, and twelve in the adult group, with five deaths. Obviously, the age of the subject is an important consideration in the death rate, and resection in early life is a formidable procedure. The literature bears out our own figures. Woodhall considers that resection in young children carries a mortality of at least 70 per cent, and Ladd and Gross had only two recoveries in thirty resections in this age group.

My personal feeling is that the tendency to perform additional surgery at the time the intussusception is reduced is entirely unwarranted. My experiences as a surgical resident have convinced me of the wisdom of the rule that surgery which is not absolutely necessary is contraindicated in the course of an emergency operation. An *analysis of the cases in this series bears out* this opinion.

The appendix was removed in forty-three cases, thirteen of which ended fatally. That the additional operative procedure was the cause of the fatality it is not possible to say definitely. It is clear, however, that the condition of the appendix or of its *blood* supply did not demand the appendectomy in any but *a few instances. It is difficult to* believe that such a procedure was warranted as was undertaken in one infant five months of age: reduction of the intussusception through a median incision,

followed by appendectomy and cecostomy through a McBurney incision. It is easy to believe, however, that the baby died.

To perform appendectomy in the hope that the resulting adhesions will fix the ileocecal region and prevent recurrence of the intussusception does not seem logical. Of equally questionable wisdom or value is cecopexy or colopexy, which was performed thirty-two times in this series, with fourteen deaths. Recurrence is supposed to ensue in less than 2 per cent of all such cases, which does not warrant the risk of the additional procedure.

Ladd and Gross share my personal opinion as to the folly of additional surgical procedures. In their series the appendix was removed only once in the last five years. They are also opposed to the removal of Meckel's diverticulum. In their series this was done seven times, with five deaths, as against no deaths in the three cases in which a diverticulum was present but was not removed. Meckel's diverticulum was excised twice, with one death, in the Charity Hospital series.

The removal of a tumor which may be responsible for the intussusception is in quite a different category, particularly in adult subjects. Even in such circumstances, however, it is well to defer the procedure until a later date if there is the slightest doubt as to the condition of the patient. The tumor was excised four times in this series, with no fatalities. Enterotomy for the removal of a tumor was performed twice, in patients four and fifty-nine years of age, and resection twice, in patients fourteen and forty-eight years of age.

ANESTHESIA

In adults the choice of anesthesia is largely a matter of the surgeon's preference. I myself prefer spinal anesthesia. In infants the decision is between ether and local anesthesia, Ladd and Gross, as well as McLaughlin, preferring ether.

In this series ether, sometimes with the addition of local analgesia (five cases) or nitrous oxide (one case) was used in sixty-four cases and chloroform in one (a very early case), with a mortality of thirty-three cases, 51.5 per cent. The mortality for ether anesthesia in the infant group was 61 per cent, in the intermediate 30.7 per cent, and in the adult group 36.3 per cent.

Spinal analgesia was used in fourteen cases with one death, 7.1 per cent. Three patients in this group were infants under two years of age, all of whom recovered. Local analgesia was used in twenty-two cases, with thirteen deaths, 59 per cent. Eighteen of this group were infants, thirteen of whom, 66.6 per cent, died. In four cases in which nitrous oxide, with or without local analgesia, was used, there were two deaths, and there were eight deaths in the sixteen cases in which it is not clear what type of anesthesia was used.

INCISION

It is doubtful that there is any direct connection between the type of incision and the mortality of intussusception. In this series the right rectus was used in sixty-six cases with twenty-six deaths, 29.4 per cent; the left rectus in seventeen with eleven deaths, 64.7 per cent; and the median in sixteen, with eight deaths, 50 per cent. The type of incision was not mentioned in twenty-one cases, in which eleven deaths, 52.3 per cent, occurred.

Four eviscerations occurred in this series, in three cases following a right paramedian, a right rectus and a left rectus incision, respectively. In the fourth case it is not clear what type of incision was used. In a fifth case the intussusception itself was discovered after an evisceration following operation for a ruptured appendix.

The fact that the mortality was highest in the cases in which a left rectus approach was used seems to indicate that in these cases the pathology was further advanced; it is known that the mass presents on the left side in the most advanced cases of intussusception. Ladd and Gross, who formerly used a midline incision, have recently expressed a preference for the right paramedian type. Hipsley uses a muscle-

splitting incision if the intussusception has been partially reduced, otherwise a paramedian or midline incision.

POSTOPERATIVE COMPLICATIONS

Shock was the most important postoperative complication in this series. It was undoubtedly responsible for the four deaths which occurred on the table, and undoubtedly played an important part in the thirty-three deaths which occurred within twenty-four hours and the additional thirteen deaths which occurred within forty-eight hours of operation. In other words, in fifty of fifty-seven deaths, 8-.- per cent of the total number, shock played either the major rôle or an important contributory rôle. Toxemia and dehydration were also important. It is interesting to observe, in this connection, that 85 per cent of the deaths in Ladd and Gross' series occurred within forty-eight hours.

In view of the rôle played by shock in the fatal outcome, it is clear that in spite of the urgent need for prompt treatment in these cases, measures to treat shock and correct dehydration should be employed before operation in every severe or long-standing case of intussusception. It is not possible in this series definitely to correlate postoperative treatment and mortality, but there is no doubt that one of the most important considerations in the reduction of mortality observed in recent years has been the improvement in preoperative and postoperative treatment. The maintenance of body heat in infants before and after operation and the return of these children to a full feeding schedule as promptly as possible were also important considerations. The use of parenteral fluids is important in every age group, and particularly important in children and in individuals advanced in years.

Other important complications in the order of frequency included wound infections (sixteen) and pneumonia (seven). There were four eviscerations, as has already been mentioned. Other complications and complicating diseases included malaria, tuberculosis, smallpox, otitis media, convulsions, bronchitis and intestinal parasites. Diarrhea was frequent but was alarming in only one instance.

MORTALITY

Excluding one case, in which the mother removed the child from the hospital as soon as operation was advised, the mortality for the series of 150 cases was seventy-eight, 52 per cent. The surgical mortality was fifty-seven of 121 cases, 47.1 per cent, and has shown a successive improvement as the series progressed. From 1905 through 1916 the surgical mortality was sixteen of twenty cases, 80.0 per cent. From 1917 through 1927 it was twenty-three of forty-two cases, 54.8 per cent. From 1928 through 1938 it was eighteen of fifty-nine cases, 30.5 per cent. This deplorable death rate, which becomes correspondingly higher when the nonsurgical cases are included, is to be compared with the 11 per cent recently reported by Hipsley and the 14 per cent recently reported by Ladd and Gross.

Part of the high mortality at Charity Hospital can be explained by the fact that the series consists entirely of ward patients, whose delay in seeking medical attention corresponded, as always, to their level of intelligence and education. It is a curious fact, however, that the negro mortality, which in most acute diseases at Charity Hospital is higher than the white mortality, in intussusception was actually slightly lower, thirty-four of sixty-eight cases, 50 per cent, as compared with forty-two of eighty white cases, 52.5 per cent.

Excluding the recurrent or chronic cases, in which the long duration of symptoms introduces a factor of confusion, a clear connection is observed between the duration of illness and the mortality, especially when age groups are taken into consideration. In the infant group the mortality was 57.0 per cent when the duration was less than twenty-four hours, 85.7 per cent at the end of twenty-four hours, and 100 per cent over that period. In the intermediate

group there was no mortality when the duration of symptoms was twenty-four hours or less, but a 33.3 per cent mortality at the end of two days, and a 28.5 per cent mortality at the end of three days. In the adult group there was no mortality when the duration of symptoms was forty-eight hours or less, though seven of ten patients died when the duration was seventy-two hours or more. The trend of the mortality rates in relation to age and duration of illness are clear, though only in the infantile group is the number of cases large enough to warrant statistical conclusions.

There is no doubt that the most important factor of mortality is the duration of symptoms before operation. Thus Davis reported a 25 per cent mortality in patients seen under nineteen hours, against 100 per cent in patients seen at the end of twenty-four hours. Thomsen (cited by Davis) had no mortality in his early cases against 81 per cent in his late cases. Bergfeld's[25] twelve-hour mortality of 45 per cent rose to 80 per cent at twenty-four hours and 100 per cent after that time.

The general mortality for the Charity Hospital series was 52 per cent, seventy-eight of 150 cases. There were fifty-six deaths, 63.6 per cent, in the eighty-eight cases under two years of age, seven deaths, 21.9 per cent, in the thirty-two cases between two and fifteen years of age, and twelve deaths, 42.8 per cent, in the twenty-eight cases over fifteen years of age. Hipsley reported an 11 per cent mortality in the 486 collected cases and a 6.6 per cent mortality in 210 personal cases. Wade[3] reported a mortality of 14 per cent in 519 collected cases. Brown and Waterman (cited by Miller[26]) reported a mortality of 74.6 per cent in infants, 31 per cent in children and 36 per cent in adults.

The general mortality for intussusception is thus seen to be very high, though practically all series show an improvement in recent years. That improved surgical judgment and technic and better preoperative and postoperative care have played their part in the improvement there can be

no doubt. On the other hand, perhaps even more important are the indefinite factors arising from the education of the laity in regard to the importance of early medical treatment in acute abdominal conditions, and the growing tendency on their part to seek earlier hospitalization.

Of the thirty patients who received no surgical treatment in this series, six either improved spontaneously or recovered after barium enemas which were being given for diagnostic rather than therapeutic purposes. A seventh patient refused operation and left the hospital against advice. The diagnosis was definite in all of these cases. In the twenty-three remaining cases the diagnosis was either missed or the patients were moribund and died so promptly after admission that treatment could not be instituted.

POSTMORTEM FINDINGS

Postmortem examination, which was performed in sixteen of the seventy-eight fatal cases, sheds little additional light on the condition, with one exception. According to Elliot-Smith[27] the lethal factor in irreducible intussusception, especially in infants, is intestinal obstruction, peritonitis from the gangrenous loop being a rare complication. In the sixteen postmortem examinations in this series gangrene of the intestine was present in four of the nonsurgical and two of the surgical cases, and peritonitis was present in three surgical cases. In one nonsurgical case both gangrene and peritonitis were found. Since the peritonitis in the surgical cases can be assumed to be the result of the operative procedure rather than of the intussusception per se, these postmortem observations would seem to bear out Elliot-Smith's contention.

SUMMARY AND CONCLUSIONS

One hundred fifty-one cases of intussusception occurred in the Charity Hospital of Louisiana at New Orleans in the thirty-four-year period ending in 1938.

The general mortality of 52 per cent was considerably decreased in the later years of the analysis, when diagnostic and therapeutic methods were both improved.

Delay in seeking medical attention was the chief cause of the shocking death rate, although in some instances the outcome might have been better had radical surgery been used, or had additional unnecessary surgery been omitted.

In age distribution, type of pathology, symptomatology and causes of death this series does not differ from other reported series.

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REDUCED TEMPERATURES IN SURGERY

I. SURGERY OF LIMBS

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FOR about ten years I have been trying to make an experimental approach to the problem of diabetic gangrene, and have carried out the observations at intervals whenever the existing obstacles could be circumvented. The views expressed in this paper rest on a growing series of clinical cases observed since the first announcement[1] in 1937 and especially on a primary laboratory foundation comprising hundreds of experiments on rats, rabbits, cats and dogs.[2-8] Prevailing conditions seem to warrant a general outline of ideas and methods, though the work is still in progress and more detailed reports will be published elsewhere. Some statements made here briefly or doubtfully may be subject to correction or amplification with larger experience.

EXPERIMENTAL METHODS

In order to study conditions of inadequate circulation, observations were made on tissues deprived of all blood supply by a tourniquet. The essential finding was that the modification of local metabolism by temperature enormously influenced the survival, from a few hours or even minutes at elevated temperatures to fifty-four hours at a temperature near freezing. No attempt was made to attain a maximum time limit, but the preservation of isolated tissues for weeks and months in the icebox is familiar; and if technical difficulties were overcome, it seems possible that attached limbs might be kept bloodless for very considerable periods and then restored to usefulness.* It is noteworthy that during fifty-four or more

hours of refrigeration the blood does not clot, the vessels do not suffer damage resulting in subsequent thrombosis and the skin and other tissues remain fresh and intact. Paralyses and other nerve injuries are either prevented or minimized by cold. The investigation properly included systemic shock, since this has relations with diabetic surgery on one hand and with diabetic coma on the other. Both primary and secondary shock are abolished by suitably low temperature.

CLINICAL METHODS

The clinical applications for amputations and other procedures may be described under the following heads:

1. *Tourniquet.* The tourniquet consists of two turns of a rubber tube to create the narrowest possible zone of compression. The clamp holding the two ends is kept from pressing on the skin by means of a gauze pad. Correct application of the tourniquet is one of the important details. Empirical judgment has thus far been the only guide for the degree of tension, which should be the least that will positively stop all blood flow. Therefore, in some arteriosclerotic cases or in shock this tension may be less than in the normal and much less than in a hypertensive patient. The rule that a tourniquet must not be applied to a diabetic or arteriosclerotic limb is set aside by cold. Just as the vessels of normal animals can tolerate a tourniquet for a day or two, so also the clinical experience thus far has shown no signs of serious or lasting damage to the most arteriosclerotic diabetic vessels by constriction up to five hours at a temperature near freezing. But as excessively tight ligations produce ulcerations, paralyses and thromboses in animals, simi-

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* Using very accurate temperature control, Brooks and Duncan (*Ann. Surg.*, 112: 130–137, 1940) have shown the survival period for rats' tails to be above ninety-six hours.

lar consequences may reasonably be expected in patients. The practical experience indicates, however, that the margin of safety for these comparatively brief periods of only a few hours in patients is so wide that there need be no extreme fear in applying a tourniquet with any reasonable care.

2. *Refrigeration.* The first clinical employment copied the procedure used in animals, by having the patient sitting up or propped up at a sufficient angle to allow the leg to be immersed in ice water to a level about one inch above the tourniquet. The advantages of this method are that the cold is maximal, reaches every part of the skin and yet cannot freeze the tissues. Next, weaker patients were allowed to lie with only a slight elevation of the head of the bed, and with the protection of a rubber sheet the leg or thigh was placed on a layer of ice and covered completely with cracked ice. To obviate inconvenience and mess, a third step has been taken by using ice bags. The thinnest and most flexible pure-gum bags should be used, and three to five teaspoonfuls of salt added to each.

The limb is first surrounded with a few ice bags at the level chosen for the tourniquet. Within five to fifteen minutes the skin is chilled so that the application of the tourniquet may cause scarcely any discomfort. If the limb contains any important amount of noninfected blood, it may be elevated to drain out as much as possible and the tourniquet applied while it is vertical. Immediately thereafter, the limb is completely buried in ice bags to a level several inches above the tourniquet. Any pain or discomfort quickly subsides under the influence of the cold. A preliminary morphine hypodermic or other sedative may be helpful on account of nervousness in some patients, but as far as anesthesia is concerned no drugs are required.

Tests of the refrigeration should be made by occasionally inserting an ordinary laboratory thermometer between the various ice bags and the skin. Readings slightly above or below 5°C. assure the desired combination of adequate chilling and safety against actual freezing. A simple special apparatus for this purpose is under consideration and may be improved if the method is widely adopted, but the use of ice or ice bags will permit of trials in any hospital or even under makeshift emergency conditions.

3. *Anesthesia.* The time required for complete through-and-through anesthesia varies with the depth of tissue. It may possibly be as short as one hour for an emaciated shin or as long as five hours for a rather thick thigh. If it is not possible to cut the sciatic nerve at midthigh without attracting the notice of the conscious patient and without any change in pulse or blood pressure, there has been something wrong in the method of preparation. This physiological blocking of nerve conduction by reduction of temperature has some evident advantages over drugs employed either locally or systematically for this purpose.

Still more important is the realization that every form of anesthesia known or used heretofore is limited to mere nerve anesthesia, while refrigeration introduces the fundamentally new conception of anesthesia of protoplasm. It is a matter of elementary knowledge that plants and protozoa without nervous systems exhibit chemical protoplasmic reactions to injury. Equally familiar is the fact that operations under any known anesthetic are productive of shock in proportion to the duration and degree of tissue trauma. Mitigation of this recognized harm has been sought only through speed and delicate precision of the skilled operator. Crile had a true vision in his anoci-association, but only refrigeration inhibits all protoplasmic activity including the shock response. Thus for the first time the surgeon has the opportunity of working in a bloodless and shockless field. Such details as duration and extent of dissection are wholly immaterial; all that matters is the condition left after completion. Shock is nonexistent except for the (usually slight)

degree of it which may develop from the tissue injury remaining after the wound is finally closed and the temperature is raised

might be opened in winter or artificial cooling provided in summer.

When all is in readiness for closure of the
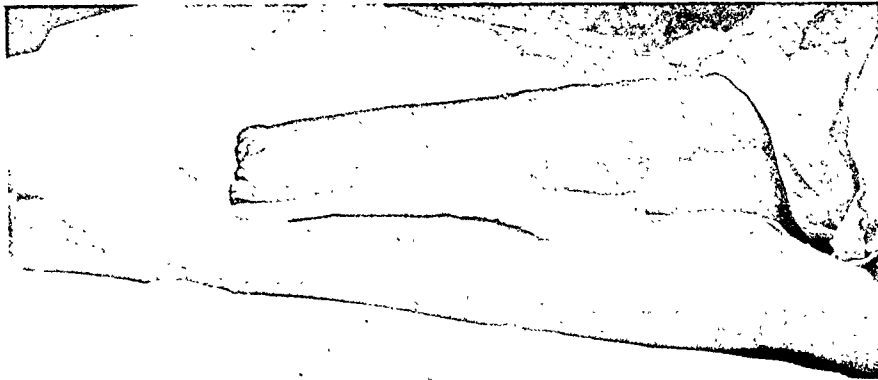
Fig. 1. Illustration showing leg of woman five days after amputation.

to allow the protoplasm to resume its functions. This explains why a reasonably strong patient, after a thigh amputation by this method, can immediately return to the ward and eat a full meal as though nothing had happened, and in general why this anesthesia offers a radically new approach to the ideal of accomplishing an operation while maintaining a constitutional condition as if there had been no operation.

4. *Operation.* It is assumed that the tourniquet has been placed at the lowest level which will permit of preparing a sterile operative field and also not impede the sawing of the bone or other procedures. In the operating room the limb is removed from its nest of ice bags and the sterilization and operation completed as usual. No extraordinary haste is demanded, because the chilled tissues remain cold during an ample time for an ordinary operation. A rise of temperature does not affect the anesthesia, which is still thoroughly maintained by anoxia, but it is inimical to the perfect preservation of tissues and avoidance of subsequent shock. If saline solution is to be used for sponging or other local purposes, it should be iced. For any particularly long operation the limb may be kept on a bed of ice bags. Contrary to usual custom, the cooler the atmosphere of the operating room the better, and there is even the possibility that for operations lasting one to several hours the windows

wound, the tourniquet is released. Circulation returns promptly, in a degree proportioned to the existing arterial supply, and bleeding points can be caught and ligated. The anesthesia then continues at least long enough for convenient completion of suturing.

5. *After-Care.* The guiding principle of postoperative management is to reduce the temperature to whatever extent may be necessary but to raise it as fast and as far as may be safe. In cases with an adequate blood supply, there is no objection to letting the stump return immediately to normal body temperature. The abundant proof of normal healing in animals by this method has been duplicated in the small human experience including both thigh and calf. But by means of temperature regulation a whole series of important new controls become available when needed:

(a) When there are threatening signs of loss of vitality in wound flaps or mutilated tissues, the surgeon heretofore has stood helplessly by and watched them slough. The sloughing is obviously due to a deficient supply of nutrition, especially oxygen. There is no means for an immediate and effective increase of blood supply, but it is immediately possible to reduce the tissue metabolism to a level for which the existing blood supply is adequate. When necessary the temperature can be lowered to a point at which tissues can survive for a considerable time without any circulation

Some experiences indicate that such control can actually be maintained during a critical period until the circulation improves.

(b) If the operation, shockless in itself, has left damaged tissues which may set up postoperative shock, especially in a weak patient, this danger period can be bridged by temperature control. Shock production by tissues is inhibited in proportion as their temperature is reduced. The temperature may be raised gradually according as not only the local tissue vitality but also the constitutional state may permit.

(c) A fundamental problem of surgery is created by the tendency of wound edges to agglutinate and thus seal up collections of fluid which are liable to become decomposed or infected. With refrigeration just as with other forms of anesthesia, it has proved possible to close wounds completely without drainage under favorable conditions, as in the thigh. But diabetic or arteriosclerotic limbs commonly present special difficulties, because of the dangers of pressure from close coaptation of the edges, while drains have recognized disadvantages including the irritant action of a foreign body. It is known from animal experiments that the most active of all agglutinating processes, namely, that of peritoneal surfaces and especially of the omentum, is completely inhibited by cold. Human operations have added the information that agglutination and drainage in wounds can be similarly controlled. For an undetermined length of time, certainly for a number of days, the wound margins can be kept healthy and in close approximation, yet not sealed. Discharge may continue abundantly; and even if it is dark at first because of the state of the tissues, it rapidly changes under cold. It cannot decompose or become infected because enzymes and bacteria are checked by the low temperature. The profuseness of the flow shows that circulation and exudation are active at this temperature, and the bright red hemoglobin tinge indicates that oxygenation is ample and putrefaction absent. This remarkable washing of the wound with fresh exudate offers a new solution to the drainage problem, but it also can be combined with the use of drainage tubes when desired because the chilled tissues do not resent the contact of a foreign body. By raising the temperature at any time the wound margins can be made to agglutinate within a few hours and the exudate assumes the usual character or ceases.

6. *Healing.* A suitable degree of cold can maintain a peculiarly normal appearance of tissues, the skin white, the fat yellow and the muscle bright red, like perfectly preserved meat in a refrigerator. This appearance is both the result and the proof of retarded tissue metabolism. This arrest of metabolism implies a corresponding arrest not only of agglutination but of all other healing processes. Therefore, instead of the usual alternatives of prompt primary union or a breakdown followed by granulation, the surgeon encounters a new phenomenon, namely, a wound healing strictly per primam but requiring a multiple of the usual time. He must, for example, accustom himself to remove skin sutures after ten to twenty days. It is impossible to force an activity of tissues beyond the limit set by their blood supply, and the insistence that arteriosclerotic limbs must attempt to heal themselves at the normal rate has caused past disasters. Slow healing is better than no healing. On the other hand, the duration of the healing period is important for the patient and for the hospital which must house him. Therefore, the temperature of the stump should be raised from day to day up to full normal body temperature with such rapidity as the examinations indicate to be safe. On purely theoretical grounds it may be hoped that intelligent use of slightly higher temperatures at the right stage in favorable cases may appreciably shorten the convalescence.

7. *Thrombosis.* Spreading thrombosis, sometimes extending rapidly up a limb and entailing a correspondingly rapid gangrene, is due to damage of the vessel walls, arising

from bacterial action in infectious cases, from lack of nutrition and oxygenation in pure arteriosclerotic cases, or often from

weeks or months. In general these effects are greatest in proportion as the operation involves sensitive and centrally located

FIG. 2. Low calf amputation with refrigeration, performed by Dr. W. F. Ruggiero in City Hospital, New York, for arteriosclerotic gangrene and infection of entire foot; man aged eighty-three years, fourteen days after operation.

combinations of these two causes. The absence of coagulation in the ligated refrigerated limbs of animals is presumably due not so much to an inhibition of the clotting process as to a preservation of the vessel walls by cold. As bacterial activity is also prevented or retarded, the danger of thrombosis should theoretically be avoided or minimized. This expectation seems to be fulfilled by the absence of any sign of this danger in the experience thus far. This principle may therefore prove useful, in addition to heparin, for the treatment of other conditions in any accessible parts of the body.

8. *After-Shock.* There seems heretofore to have been no discussion and nothing but tacit acceptance of the more or less prolonged asthenia following operations. The procedure may involve apparently trivial trauma, only brief anesthesia, small incision, absence of infection, hemorrhage or immediate prostration, and little or no tissue left for later absorption; yet after a simple appendectomy or other operation conforming to these terms a previously strong and healthy patient may experience more or less debility continuing for several

organs, or with peripheral operations in proportion as large nerves and muscle masses are cut. When refrigeration anesthesia prevents the appearance of any of the signs regarded as diagnostic of primary or secondary shock, and when the patient has unimpaired appetite during the immediate postoperative period, it is interesting to learn whether he may also be spared this state of delayed shock. A clear answer cannot yet be given, because thigh amputations even when healing by primary union entail absorption of broken down tissue products and often also products of infection. All that can be said, therefore, is that following thigh amputations there is still a perceptible depletion of strength. The experience to date gives the impression that this debility is decidedly reduced by refrigeration as compared with former methods, but it may still be a source of danger to extremely feeble patients. On the other hand, with properly managed lower leg amputations this after-shock approaches the vanishing point. One of the greatest advantages of the refrigeration method, therefore, consists in promoting the success of these milder operations which

make the smallest wounds, thus favoring the survival of weak patients, or in stronger patients allowing a series of conservative trials to be risked with impunity.

DIABETIC GANGRENE

As diabetic gangrene furnished the starting point of this research, it should be discussed in a little more detail. Confessedly, the current management leaves much to be desired and the mortality is high. In no other chronic condition is prophylaxis more essential or more successful, because the arterial and other complications can be prevented by timely and thorough care of the diabetes; and a heavy responsibility is borne by those who encourage the reckless laxity which finally brings the terrible and hopeless thickening of arteries not only in the legs but in all parts of the body. When this condition has arrived at an advanced or terminal stage, no treatment can be expected to work a miracle. Nevertheless, as I find some patients living comfortably five to fifteen years after medical or surgical cure of gangrene, an effort toward lower mortality and greater longevity is not wasted. The particular question for present consideration is whether the use of cold can add anything to the existing treatment, especially in the most unpromising and desperate cases. We must first consider treatment which seeks to save the limb from amputation.

1. *Conservative Treatment.* Physicotherapy offers a variety of useful aids, none of which need be overlooked or disparaged. There has been abuse of heat treatments with the intent to promote hyperemia, but with disregard of the fact that it raises the local metabolism so as to create a need for more blood while an appreciable increase of flow through the rigid arteries is impossible. As it has become recognized[9][10] that the temperature of the feet under normal conditions is commonly lower than that of the central parts of the body, the possible dangers of warming arteriosclerotic extremities to a point equalling or exceeding the rectal temperature can be better

appreciated. These simple relations between local metabolism and blood supply explain the thermal sensitiveness of the tissues in vascular disease, for example, the burns from water bottles or electric pads, and the case which I have mentioned elsewhere of gangrene in the feet of a diabetic from a Turkish bath which was not uncomfortably hot to other persons. Nevertheless, heat is valuable in the treatment of some cases of gangrene and for years I have tried vainly to obtain facilities for what may be a more rational mode of administration. Tests may perhaps be devised to distinguish cases which are suitable for heat or cold, respectively, but one simple and fairly decisive test is the patient's comfort. Regardless of any theory, an increase of pain or discomfort by cold may be regarded as a contraindication to any prolonged use of it. On the other hand insufficient attention may have been paid heretofore to complaints of burning sensations and of increased discomfort with heat applications or even with warm coverings. Cold may be acceptable to some patients either because of insensibility of the nerves or because it actually relieves pain.

It is made clear in the useful classification of Williams and O'Kane[11] that the designation of diabetic gangrene covers cases ranging from practically pure arteriosclerosis at one extreme to practically pure infection at the other extreme, but the vast majority are mixed in varying degrees. Therefore, the possible effects of thermal changes should be estimated in relation to these two factors.

(a) *Arteriosclerosis.* There is a radical difference between a ligated limb and one with a normal blood supply. The circulatory reaction in the latter is one of the important objects and aids in physicotherapy, but at the same time it limits the ability to produce artificial temperature changes in the deep tissue. In proportion as arteriosclerosis is present the condition approaches closer to that of the ligated limb, and external applications can warm or chill the tissues through and through

with unusual ease. The small trickle of blood does not provide the usual efficient temperature regulation; on the contrary the blood itself can be heated or cooled along with the tissues. Accordingly, advanced arteriosclerosis creates a remarkable condition in which the local metabolism in certain parts of the body is subject to the environmental temperature almost as definitely as the metabolism of a frog. Omitting theoretical discussions of this interesting condition, the practical statement can be made that reduced temperatures seem to be well tolerated for considerable periods when the cases and conditions are properly chosen; fears concerning reduced blood flow or other dangers have not yet materialized, and the progress of arteriosclerotic gangrene may possibly sometimes be delayed. On the other hand, the case record included in this paper proves that a severe process of this type may continue to advance in spite of the attempt to reduce the tissue metabolism to correspond to the reduced blood supply. A definite opinion must, therefore, be withheld pending fuller experience. Furthermore the incurability and possible progressiveness of arteriosclerosis limit the possibilities.

(b) *Infection.* Arteriosclerosis creates an opportunity which is practically unobtainable in tissues with a normal blood supply, namely, the ability to make a through-and-through reduction of temperature low enough to arrest activities of pathogenic bacteria. Some facts bearing on this condition are stated elsewhere. The usefulness for the conservative treatment of diabetic gangrene is not a matter for theoretical hope or condemnation but must remain to be decided by longer experience.

2. *Surgical Treatment.* Proper control of temperature can be an aid to conservative surgery. The remarks concerning drainage, shock, tissue vitality, etc., in the first section of this paper are applicable to drainage treatment without amputation or the more conservative forms of amputation. An example may be the prevention of failures of healing with plastic types of

operation. Likewise the opportunity for amputations through the calf may be enlarged. The present discussion, however, will go further into the problem of surgical mortality in critical cases. Two of the principal forms of emergency will be considered as examples.

Fulminating Infections. Retention of a hopelessly infected leg may mean certain death, while amputation often carries extreme risk from shock alone or from lowering of resistance to a beginning systemic infection. New and old uses of cold may be distinguished as follows: (a) Ice bags for various purposes have long been familiar, and some of the older surgeons occasionally packed infected limbs in ice. (b) Dr. Temple Fay and collaborators[9,10] opened a new epoch not only with more efficient means of local chilling but also with the brilliant and daring discovery of general systemic refrigeration, as a broad biological approach to problems inclusive of cancer, pain and infection. These striking contributions should be more highly appreciated and further developments encouraged. (c) The present work had a different and narrower origin. Its distinctive original feature is the use of the tourniquet with cold. In other respects it is an adaptation of previously known principles.

The existing situation today is that in the most desperate cases surgeons customarily take the risk of a high amputation or else let the patient die as inoperable. It is clear that refrigeration offers an alternative, and the use of a tourniquet can add all the advantages of operation without the shock. The simple packing in ice will often transform both local and general conditions and may check pain and the advance of sepsis for perhaps several days. When necessary, the tourniquet can give a still more decisive result, obviating the need of morphine and the waste of time and strength in preparing for operation. If applied promptly by anybody on the resident staff, it will within a few hours permit of amputation without an anes-

thetic and with minimal shock. If the condition is so extreme as to make any operation inadvisable, the limb can be left for a few days or can be harmlessly amputated or disarticulated anywhere below the tourniquet in order to reduce the mass to be kept refrigerated. The time for the finished amputation can then be selected according to the patient's strength.

It is important to warn that when a tourniquet has been in place for one to several days, it must never be removed or allowed to slip. An excessively rapid and fatal intoxication may result. At the proper time another tourniquet may be applied a few inches above the original one, and after the few hours necessary for anesthesia the amputation may be performed a little above the original tourniquet.

Amputations of Election. Somewhat less urgent but more numerous are the cases of lower grade infection or of dry gangrene. At present there is only a minor difference in judgment concerning a few of these cases, whether to get rid of the focus of intoxication by a preliminary low guillotine operation (McKittrick) or to make a finished procedure in one stage. The end in view is nearly always the same, namely, a thigh amputation. Statistical results are comparatively good in a few institutions having the advantages of special skill and organization. The fact remains that the great mass of these cases are treated in public hospitals, where the deplorably high mortality is accounted for not only by the possible lack of specialization but also by the wretched average state of the clientele. The age and complications in many of these cases will create a considerable mortality regardless of any medical or surgical efforts. We may, however, distinguish a certain large nucleus of mortality which is due to enforced major amputations upon poor risk subjects. The elementary facts can be further analyzed as follows:

First, the risks of high amputation are taken because of the proof through long experience that low amputation wounds generally will not heal. But gangrene nearly always starts in the feet. Except in a small minority, the indications are that all tissues above the ankle could have remained safe throughout life had there been no trouble in the foot. In fact, the rules for care of the feet stressed by Joslin and all other writers are based on the assumption that prevention of small injuries and infections will often allow the feet also to survive without gangrene. Therefore, the failure of tissue survival after operations anywhere below the thigh must be due to something connected with the operation.

Second, this operative injury may be subdivided into the factors of local shock, infection and edema. Accessory causes of trouble have been: (a) too high local temperature, due either to artificial heat or unduly warm dressings and coverings; (b) the abuse of saline infusions, for in the zeal to provide circulating fluid it has been forgotten that salt solution increases the tendency to local edema, and the pressure of edema upon capillaries is a cause of disaster with feeble circulation. The tissues which could survive if uninjured are unable to withstand this multiple damage. It has already been explained that refrigeration combats all of these factors and will thus conduce to healing after conservative operations.

Third, the rules for amputation sites for the best functional results in favorable cases are not the object of this discussion. The one point for consideration is the saving of life in the worst cases. Concerning these arteriosclerotics the radical thesis may be proposed, at least for debate, that surgeons directly cause many deaths by clinging to the traditional practice of amputating through the thick bellies of muscles in the thigh or calf. Because the foot is a complex of structures supplied by the smallest arterial branches, amputations anywhere in it are recognized as not feasible except in the small minority of cases with best circulation. But amputations in the supposedly forbidden zone of the lower half or third of the tibia can be defended

in comparison with the traditional elective sites by the following arguments:

(a) The smallest wound produces the least shock and should also be the easiest to heal.

(b) The muscle masses possess the largest blood supply for the very reason that they demand the most blood. Therefore, they slough easily with a deficient blood supply and the necrosis of these large flaps is ruinous. Shock is maximal.

(c) The usual amputations below the knee have the above disadvantages, also the weight and pull of the calf muscles contribute to force the tibia through the skin. The small mass of the flaps near the ankle imposes less strain on the skin. Also if any sloughing occurs, there is a chance to wait for granulation and saw off the bone again because of the small wounds and small shock in these procedures.

(d) A traditional objection is that the lower shin consists largely of tissue of low vitality. The very fact of the low vital activity of tendons and fascia furnishes the reason why they can survive with less circulation.

(e) The chief argument, namely, that there is not enough blood supply in the ankle region, may often be untrue. The bone, which composes most of the diameter, has its own blood supply for its own small needs, and practically never sloughs primarily. As was previously explained, there is ordinarily enough blood supply not only for the scanty soft tissues of the shin but often for the larger mass of the foot, if there were no wound. The problem, therefore, is merely that of tiding over the brief period of the recent wound.

(f) Particularly in shrunken arteriosclerotic limbs, it can be objected that a lower shin stump will be pointed, tender and liable to ulcerate. All this is immaterial in comparison with saving of life. If the patient is never to walk, as is admittedly true with a large proportion of thigh amputations in senility, there is a minimal chance of trouble with any stump. But walking does not demand that the stump

end shall bear weight or be chafed; and with a suitable prosthesis for carrying weight on the bony expansions about the knee there should be more chance of walking, and of better walking, than with thigh amputations.

(g) The possibility that the small atrophic stump may be subject to neuritis or to further gangrene as a result of progressive arteriosclerosis cannot be settled in advance, but such risks seem small in comparison with existing dangers in these cases.

The general import of this argument is that refrigeration can reduce surgical mortality by reducing the number of enforced major operations as well as by making them more easily borne. Actual experience to date indicates that the best amputation as a rule is, according to the individual case requirements, either of the Callender type or else in the lower part of the calf muscles, in both instances avoiding the largest muscle masses.

CASE REPORT

The following case, though finally fatal, illustrates certain uses of reduced temperature in an advanced and somewhat atypical case of arteriosclerosis:

A housewife, of an age unknown to herself or family but obviously senile, was seen September 9, 1940, in bed on account of severe pain in the great toe of the right foot. Moderate discoloration when dependent and other clinical signs of arterial obstruction were present. No pulsations were palpable in the popliteal artery of either leg or anywhere below. Subsequently two consultants made oscillometric tests, which showed slight pulsations in the thighs, extremely slight just below the knee, and nothing lower down.

The history was the familiar one of glycosuria known and neglected for fifteen years, with good general feelings and no loss of weight. The more recent years included one "heart attack," one psychosis for several weeks following operation, and one incipient gangrene of the right foot cured without stopping of glycosuria. One physician previously consulted for the present attack refused to give insulin because of moderate indications of coronary disease in the

electrocardiogram. Routine examinations of the heart and other organs were negative.

The diet was only slightly changed in quantity but was weighed to keep it uniform. The urine and blood were made normal by means of insulin, which at one time reached a maximum of 60 units divided into four doses daily. With fractionation of the carbohydrate allowance there were no hypoglycemic or cardiac attacks.

The control of the diabetes gave quick relief of pain, but the case was exceptional in that this improvement was brief and the further progress seemed unaffected. Another short period of relief was given by nitroglycerin, and after that by various sedatives. Vitamins seemed not indicated but were tried briefly in vain. Warmth was tried in the form of mild artificial heat or merely warm coverings, but the patient resisted them as increasing the pain at all stages. Ice bags were welcomed and gave full relief for a few days but later had little effect. The pain increased in extent and especially in intensity, without any sign of gangrene, until it dangerously exhausted the patient's strength and she begged for amputation.

Instead, it was ascertained that novocaine injections of the principal nerves stopped all pain for a few hours. Accordingly it was decided to risk a trial of nerve section. Using novocaine, Dr. J. J. Nutt, on October 31, sectioned the anterior tibial and musculocutaneous nerves in the upper calf and the posterior tibial by another short incision behind the malleolus. The posterior tibial artery was found to be a hard bloodless cord and the cut tissues did not bleed appreciably. The slight operation was followed by nearly complete cessation of pain but also by complete disorientation (supposedly connected with the cerebral arteriosclerosis) and urinary incontinence followed by retention. The taking of nourishment was not interrupted, and after four weeks the disturbances cleared up. The principal fear was that the slightest separation or infection of wounds in such a leg would be a starting point for gangrene. Therefore, reduced temperature was employed from the outset, first with ice bags and later with exposure to a cool atmosphere. Healing occurred strictly per primam but with extreme slowness, so that narrow lines of superficial crust were still present two months later.

Meanwhile a gradual darkening began in the third toe and progressed to mummification, and this process spread to the two adjacent toes and then into the foot. Apprehension was felt that the advancing arteriosclerosis might be related to two unorthodox features of the treatment, namely, the reduced local temperature and salt-free diet. Therefore, tests were made which gave unfortunately positive results in this case, regardless of what may hold for other cases, and without these tests the outcome might possibly have been different. Two trials were made of keeping the leg warmly covered, with the result of an accelerated advance of the discoloration, also a threatening appearance of the wound behind the internal malleolus. On two other occasions salt was tried, with avoidance of hypertonic solutions which were said by the family to have caused serious shock in a former experience. On the first occasion salt was added to the diet ad libitum, and two liters of plain physiological saline were given by slow intravenous infusion in the course of the day. On a later occasion 2 Gm. of salt were added to the diet and one liter of saline was infused. Each time there was an immediate appearance of better circulation in the foot, but after twenty-four hours a slight edema was present. Over areas adjacent to the gangrene the epidermis was lifted up by a slight transudation from the soggy tissues, and these superficially blistered areas immediately turned black. In this way a rapid extension of gangrene occurred into the adjacent toes and then in the foot.

Although the advance of the gangrene was not stopped, it seemed to be distinctly slower at low temperature. Also no infection or wet gangrene appeared, and the rectal temperature remained strictly normal throughout. When the discoloration extended half-way back in the foot on both dorsum and sole it was agreed that a trial of a low amputation was preferable to the practically certain fatality of a thigh operation.

Therefore, on December 22, the leg was surrounded with salted ice bags from the knee downward, to give readings of about 5°C. on a thermometer inserted between bag and skin. A rubber tube was applied as a tourniquet around the calf for three hours—doubtless an unnecessarily long time. Dr. Robert E. Brennan then amputated in the lower third of the tibia, barely shaping the flaps and avoiding all dissection. He also omitted bevelling of the tibia upon request, which was probably an error. The obliterated arteries did not bleed and the tissues were nearly bloodless but a few catgut ligatures were placed as a precaution. A very light dressing of only a few thicknesses of gauze was applied with ice bags arranged outside it

so as to avoid pressure. The thermometer readings inside the dressings were kept at about 15°C. for the first twenty-four hours, and gradually raised to 35°C. by the end of a week. A rubber tube drain was withdrawn after only twelve hours, but a clear reddish drainage continued rather freely for several days until checked by the rise of temperature. The wound edges remained perfect. In spite of the small weight of the flaps, the sharp crest of the tibia made a threatening pressure point on the skin, which cleared up with support of a posterior pad and increased refrigeration anteriorly for two days. No physical or mental disturbance appeared following the operation. After one week, when the patient was symptom-free and was hoped to be out of danger, the pulse rate dropped suddenly to 50. A blood analysis showed the sugar was not low but instead had risen to 250 mg. Death ensued early the next morning, presumably from heart block.

Figure 1 shows the thigh with a large fold of flabby tissue and the shrunken lower leg. The wound flaps and the point of exit of the former drain are free from any trace of necrosis. The death appeared to be unrelated to this small operation. The complete healing of the neurotomy wounds and the smooth beginning of healing after the amputation seem to illustrate the possibilities in an extremely advanced stage of arteriosclerosis.

MILITARY SURGERY

Refrigeration is applicable to other conditions not handicapped by senility and arteriosclerosis. One of the strongest reasons for presenting the subject at this time is its apparent value for war wounds. Industrial accidents furnish a more continuous supply of similar cases.

The theory of shock should be considered with reference to the nervous and chemical causes. For the latter I proposed the tentative and unsatisfactory names of histotoxins and histotoxicosis. The combined nervous and humoral action is not inherently harmful, but rather serves to produce dilatation and increased permeability of blood vessels as the primary stage of a normal defense and repair. Hypothetically, an excess of this reaction, either absolutely or in relation to the available blood supply,

may be locally injurious and warrant the name of local shock. The most severe and extensive injuries, through excessive nervous stimulation and the flooding of the circulation with histotoxins, produce effects such as low blood pressure and abnormal vascular relaxation and permeability to a degree which may be fatal. Whatever progress may have been made in the treatment of any of these factors in shock, the pre-eminent desideratum is still prevention. A large number of both military and industrial wounds consist in mutilations of limbs, and to these the results of animal experiments are clearly applicable as follows:

1. *Emergency Facilities.* In warm weather ice is often available or can be specially provided. In cold weather only precautions against actual freezing of parts may be needed. The chilling is so simple that it can be carried out by any reasonably intelligent nonmedical persons.

2. *Tourniquet.* A tourniquet is often needed to stop hemorrhage, and it sometimes remains in place for several hours pending surgical treatment. Histotoxins are produced in proportion to the mass of asphyxiated tissue and the duration of the asphyxia, and they are poured into the circulation upon removal of the tourniquet. Ligation of one entire hind leg for five hours is enough to kill a rat, and deaths from this cause alone have been reported in human cases. In nonfatal cases there will still be various degrees of reduction of strength and resistance. Efficient chilling prevents this shock effect largely or entirely, and also wards off local gangrene when the tourniquet is retained for an excessive length of time.

3. *Transportation.* The transportation of wounded persons can be made entirely painless as far as limb injuries are concerned. There is probably better preservation of strength and resistance than with large doses of sedatives.

4. *Anesthesia.* The wounded may arrive at a hospital after several hours, ready for immediate operation without any additional anesthetic.

5. *Shock.* The prevention of shock before, during and after operation was previously described. A caution maybe necessary concerning the time limits. Although it is possible theoretically to conceive of a preservation of ligated limbs for several days, any apparatus that could carry this theory into practice would be too complicated for emergency use. Mere external icing is inadequate for prolonged through-and-through chilling of thick limbs, notably the human thigh, and internal parts near the tourniquet may still be warm enough for gradual toxin formation or even necrosis. Appropriate precautions should therefore be taken, even to the extent of amputation, if a tourniquet has been in position perhaps for eighteen hours or longer.

6. *Infection.* When any parts are potentially infected, perhaps by being macerated with dirt and foreign material, refrigeration serves the important purpose of holding everything in abeyance. Bacteria cannot grow or invade. Tissue vitality and resistance are preserved. In cases of existing active infection, the animal experiments and a few clinical observations indicate that ligation and refrigeration can be used long enough for operative anesthesia, without benefit and also without apparent harm as regards the infectious process. Any extreme prolongation of ligation of an actively infected part creates dangers of intoxication and death which necessitate precautionary amputation.

7. *Ultimate Results.* The preservation of tissue together with suitable temperature reductions in the postoperative care, should facilitate conservative and reparative operations and aid in avoiding amputations and crippling.

The chief difficulty will perhaps consist in persuading surgeons that a refrigerated limb, no matter how cadaveric it may appear, actually retains vitality so as to offer the above stated advantages; and that therefore one of the most revolutionary achievements of this method may be hoped for in the field of military and emergency surgery. A very striking case of this type is described by McElvenny.[12]

EMBOLISM AND OTHER ACCIDENTS

Embolism of a main artery is one of the conditions in which warming a limb is most disastrous. Any person present may be instructed as early as possible to surround the limb with ice. A suitable degree of refrigeration will be the most important nonoperative treatment. In case of a high embolism which obviously demands operation, a physician should preferably use brief elevation to drain out all possible blood, then apply a high tourniquet to stop all inflow from collateral vessels. The refrigeration will then have its usual effects in inhibiting pain, shock, tissue damage and intravascular thrombosis, besides permitting of operation without an added anesthetic. Postoperative regulation of temperature is also important to suit the individual case. Reduced temperature can further restrain thrombosis, necrosis and infection. Parts which lack circulation are fortunately the ones which can be most effectively chilled, hence they can be aided in survival until collateral circulation has a chance to develop. The method should make a transformation by extending the time limits for embolectomy and improving the results.

Refrigeration is of questionable value for ordinary fractures, and account must perhaps be taken of the increase of tissue rigidity by cold. For open fractures the previously stated principles concerning infection are applicable. Fractures damaging blood vessels may need treatment along the same lines as embolism. Fractures involving shock also come within the scope of these principles.

In addition to the obvious uses for plastic and reconstructive work, it may not be difficult to suggest other possible applications of refrigeration and the ideal of working in a bloodless and shockless field. The attempt will be made as opportunities permit to try further extensions both experimentally and practically.

CONCLUSION

Every new method must have its value tested, its limitations defined and its technic developed before it can receive an established status. The obstacles to investigation heretofore, together with the existing military emergency, furnish the reasons for presenting this method before these requirements have been fulfilled. A broad statement of theories has seemed desirable in order to stimulate investigation by those who have opportunities, even though one result of such work will doubtless be to destroy some parts of the speculative structure. The essential point which appears to be proved is that refrigeration possesses real value at least for some critical conditions. It may possibly be found suited for much wider applications. But there is as yet no proof that it can reduce the statistical mortality from diabetic gangrene, that it is superior to other operative methods in cases permitting of free choice, or that there may not be some harmful results of the drastic chilling in contrast to the usual careful conservation of tissue warmth.

Furthermore, the technic is still primitive, so that the best beneficial effects cannot yet be realized while harmful effects may be magnified. For all these reasons the first trials may properly be limited to cases regarded as desperate or inoperable, and this experience may serve as a guide to any wider adoption. Fundamental studies are the principal need, in order that undue enthusiasm over a spectacular novelty may not be followed by disillusionment which may obscure any real value of the method.

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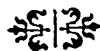
OPEN SURGICAL REDUCTION OF FRACTURE DISLOCATION OF THE LUMBAR SPINE WITH CORD OR CAUDA EQUINA INVOLVEMENT

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THE clinical course and autopsy findings of fracture dislocation of the lumbar spine with cord or cauda equina involvement has been described as

Of ninety-seven cases of compression fracture of the spine observed by Munro and Irwin in 1935 and 1936, nine patients were suffering from what appeared to be
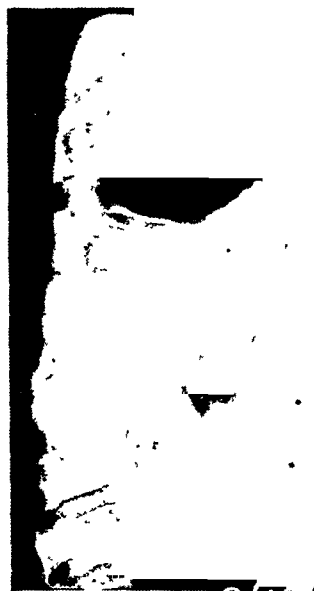
FIG. 1A. Lateral view.
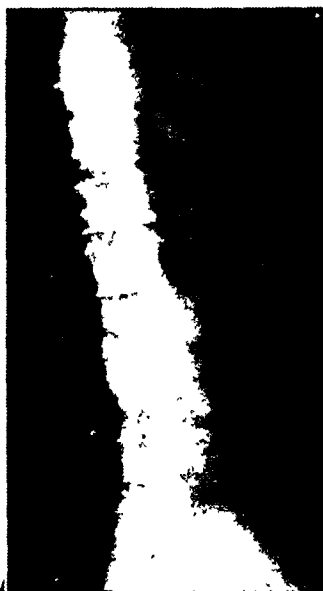
FIG. 1B. Anteroposterior roentgenograms of lumbar spine of A. C., August 18, 1939, immediately after admission to hospital.

FIG. 1C. Enlargement of Figure 1A to show more clearly the position of the articular processes on the right side of L 1 and 2.

long ago and perhaps before the time of Guillaume Dupuyptren,[4] yet in the literature of this country and that of Great Britain, there is only one instance cited in which open surgical reduction has resulted in satisfactory recovery.[6]

Numerous authors[1,2,3,7,8] have proposed open reduction in fracture dislocation with locking of the articular processes but actual cases in which such a procedure has been done have not been included.

definite cord or cauda equina complications on admission to the Infirmary. Three of these nine patients were subjected to open surgical reduction[5] and, in those so treated, one showed no change but in the other two, the symptoms of cord complications were alleviated.

Munro and Irwin state in their conclusions that open operative reduction, though criticized because it has never yet "cured" a patient, appears to be a rational

method of treatment when carried out early; and these authors express the hope that sometime a patient may be encountered and reported in whom injury to the spinal cord has not been so great as to cause irrecoverable cord damage. Therefore, the following case is presented in detail.

CASE HISTORY

A. C., a white man aged 46 years, was admitted to Samaritan Hospital in Ashland, Ohio, on the evening of August 18, 1939, following an automobile accident. Obviously the man had suffered severe spinal injury since the initial immediate examination showed an extreme kyphoscoliosis of the dorsolumbar region and a partial sensory and motor paralysis involving the right leg.

During the first four hours after admission a gradual extension of the paralysis was noted. At the consultation four hours after admission loss of motor and sensory function involved the entire right leg and the right half of the perineum. A bulging forward in the left lower quadrant of the abdomen on coughing or straining was the only evidence of motor involvement on this side of the body. There was, however, definite hypesthesia over a rather large elliptical area in the left inguinal region, of the front of the left knee and on the dorsum of the left foot. The patient also voided involuntarily.

Anteroposterior and lateral roentgenograms of the spine (Figs. 1A and 1B) revealed a fracture dislocation involving the first and second lumbar vertebrae. The lateral view (Fig. 1A) shows some although not an extreme amount of anterior displacement together with an obliteration of the forward part of the intervertebral space and a widening of the space between the lamina of the two vertebrae. A compression fracture extending horizontally through the body of the second lumbar vertebra near the upper plate is faintly visible. In the anteroposterior view (Fig. 1B) there is an apparent lateral displacement to the right of the first on the second lumbar vertebra and compression of the right side of the body of the second lumbar vertebra.

Open operative reduction at this time seemed inadvisable and perhaps unnecessary if reduction of the lateral displacement could otherwise be accomplished. The principal obstruction to reduction seemed to be the position of dis-

placement of the adjoining articular processes on the right side of the involved vertebrae. The tip of the inferior process of L 1 appeared to be
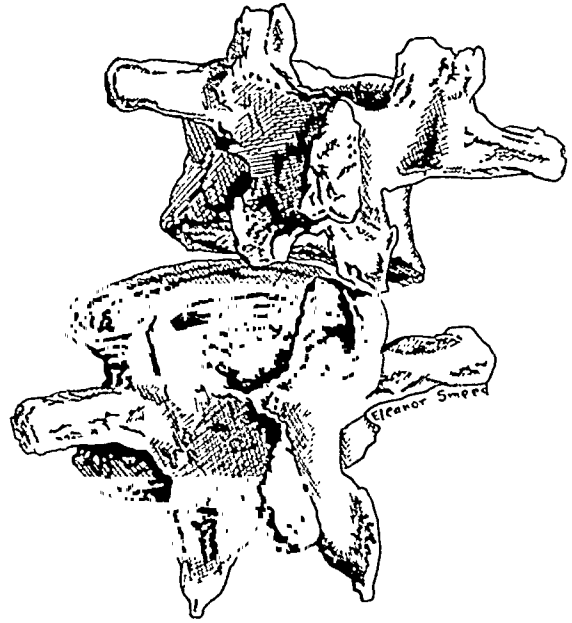
Fig. 2. Drawing of posterior view of L 1 and 2 to illustrate the position of displacement of the involved segments as interpreted from the roentgenogram (Fig. 1 c).

resting securely and a little lateral to the highest point of the tip of the superior articular process of L 2. (Figs. 2 and 3.) We believed the displacement could be favorably corrected by manipulation if it were undertaken carefully.

Scopalimine-morphine analgesia was used. After slight flexion away from the partially locked articular processes an attempt was made to derotate them from their fixed position. This was followed by traction and hyperextension. A complete disappearance of the apparent deformity resulted and, after a few hours, the patient stated that he felt greatly relieved. He voided involuntarily twice following the manipulation but bladder control returned thereafter.

Roentgenograms (Figs. 4A and 4B), made on August 19, 1939, the day after admission, show the change produced by the attempt at closed reduction. The lateral view (Fig. 4A) shows a seemingly favorable replacement of the forward dislocation of the adjacent bodies. The fracture line through the body of L 2, near its upper plate, is here more apparent than in Figure 1A and the compression appears to have been reduced. The anteroposterior view (Fig. 4B) indicates that there was little, if any, change in the lateral displacement as the result of the attempted reduction, and that any further

attempt at closed reduction would be dangerous and without benefit. The right inferior articular process of the first lumbar vertebra has been

plane as the right superior articular process of L 2, and the latter was securely placed between the inferior articular processes of L 1 (Figs. 4B

FIG. 3A. Lateral view.
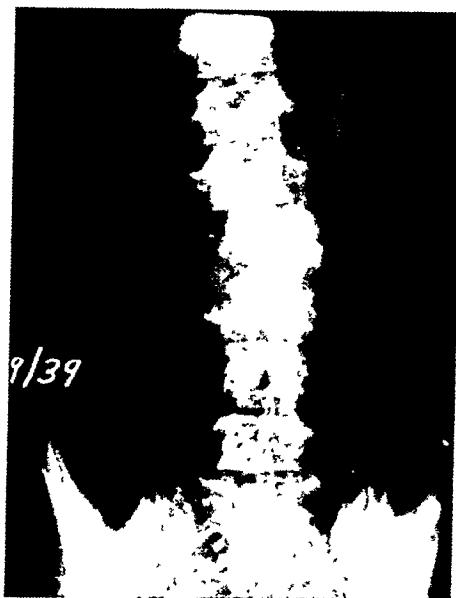
FIG. 3B. Anteroposterior roentgenograms of lumbar spine of A. C., August 19, 1939, the day following attempt at closed reduction.

forced downward along the lateral side of the right superior articular process of the second lumbar vertebra so that the two inferior articular processes of L 1 are riding astride the right superior articular process of L 2 (Fig. 5), the lateral displacement being thereby locked in this position. That some compression of the right half of the upper plate of L 2 is still present is shown in Figure 4B.

It was now apparent that an open operation offered the only means by which reduction could be accomplished and a chance for recovery attained. The local as well as the general condition of the patient necessitated that surgical reduction be delayed until August 27, nine days after the injury.

Under local anesthesia the spinous processes of the involved vertebrae were exposed through a curved incision passing to their left. An irregular tear which had completely divided the supraspinous and interspinous ligaments extended laterally to involve the lumbar fascia beyond the area of exposure. Extensive damage to the left latissimus dorsi and sacrospinalis muscles had resulted in widespread extravasation of blood which had become organized.

The spinous process of L 1 was displaced laterally so that it was in the same longitudinal

and 5) preventing rotation. By grasping the spinous processes of the involved vertebrae with boneholding forceps it was found that their longitudinal position could be appreciably changed by slight traction but not enough to disengage the articular processes. When the spine was flexed by lowering the ends of the operating table and an instrument placed between the spinous processes to steady and help direct the procedure (Fig. 6), reduction was accomplished with surprisingly little force. As a precautionary measure, to prevent redislocation, the spinous processes of the involved vertebrae were secured in position by a piece of surgical wire passed through drill holes. The operative wound was closed without drainage and a plaster of Paris shell was then moulded to the patient's back.

Postoperative roentgenograms (Figs. 7A and 7B) show the degree of correction attained. The lateral view shows a perceptible backward displacement of the first on the second lumbar vertebra. In the anteroposterior view (Fig. 7B) complete reduction of the lateral displacement obtains. The surgical wire placed through the spinous processes is seen in both views.

During the two weeks following the injury, except for a sensation of coldness, there was

complete paralysis of the entire right leg. About the end of the third week, evidence of the return of muscle power in the toes was noted.
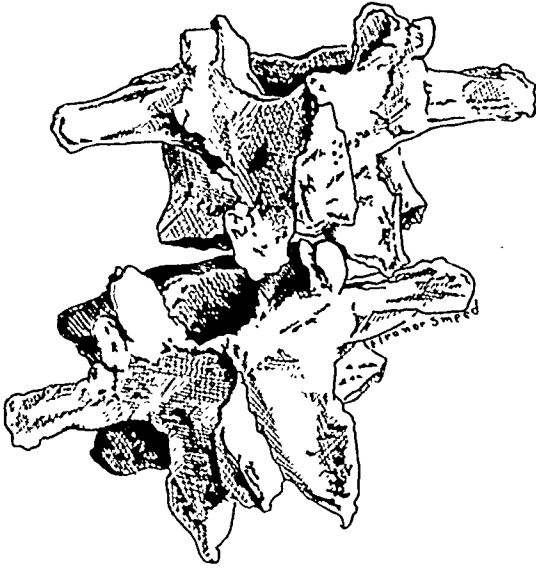
FIG. 4A. Drawing of posterior view of L 1 and 2 showing the position of displacement as interpreted from the roentgenogram (Fig. 3B).

By the end of the fourth week the patient could abduct but not adduct the entire limb. Gradual return of motor and sensory function continued; the hypesthesia of the left big toe, left knee cap and left inguinal region disappeared more slowly than that of other parts.

Ten days after operation, when the tension sutures were removed, there was a separation of the wound with a persistent discharge of a small amount of serous fluid. This was attributed to the surgical wire placed through the spinous processes. On December 10, 1939, this wire was removed and three weeks later the wound was entirely healed. The patient, now wearing body cast, was discharged from the hospital on December 23, 1939.

On February 19, 1940, exactly six months after the date of his injury the patient began sitting up and nine days later he stood up for the first time. By March 11, 1940, he was walking unaided and came to the table for his meals; the following week he went up and down stairs. On March 21, 1940, the body cast was removed and a back brace applied. Enemas were discontinued this same day and have been resorted to only occasionally since.

The patient's activities have gradually increased. During the month of April he was able to walk a distance of four miles without fatigue and on May 18, 1940, he drove his automobile for the first time.

On May 31, 1940, physical examination of this patient revealed the following conditions: He was still wearing a back brace (Fig. 8)
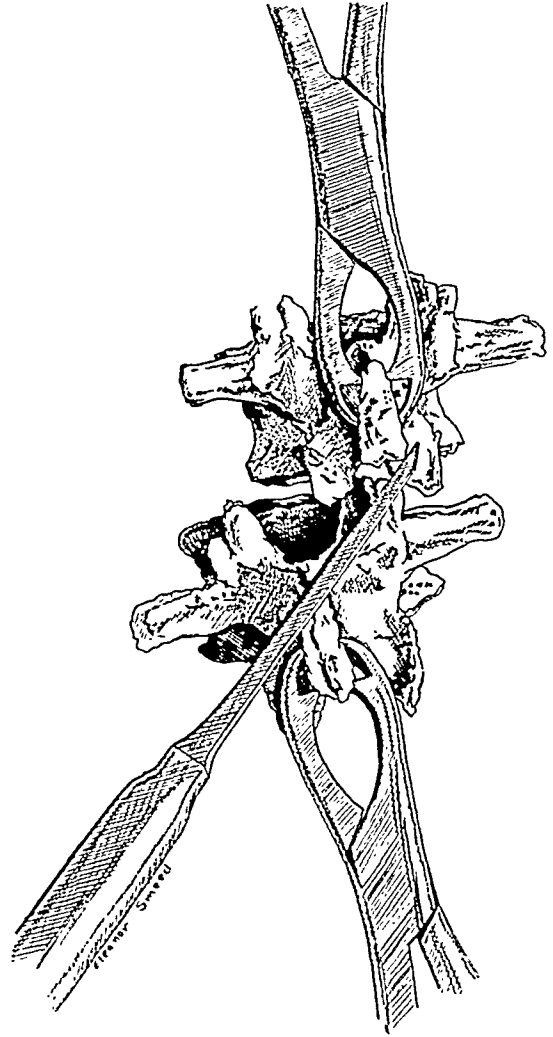
FIG. 4B. Drawing of L 1 and 2 to illustrate the manner in which reduction was aided.

except at night. His operative wound was well healed. (Fig. 9.) Although motions of his lumbar spine were somewhat limited there was no pain or discomfort on motion. By slightly bending his knees he could stoop over to pick up objects from the floor (Fig. 10) as easily now as he could before his injury. There was some weakness of his right leg but it would withstand his body weight even when the knee was flexed 45 degrees or more. (Fig. 11.) His right calf measured 12½ inches, the left 12¾; right thigh, 19 inches and the left 20½. The right Achilles and patellar tendon reflexes were less active than were those on the left side. Some weakness of the left lower abdominal muscles, evidenced by a slight bulging on coughing or straining, is still present. An area of hypesthesia, somewhat elliptical in shape and measuring about 2 to

4 inches is still present in the left inguinal region lateral to the mons pubis. The front of the left knee, the medial side and dorsum of the left

four of seventy cases of fracture and dislocation of the thoracic and lumbar vertebral bodies.

FIG. 5A. Lateral view.
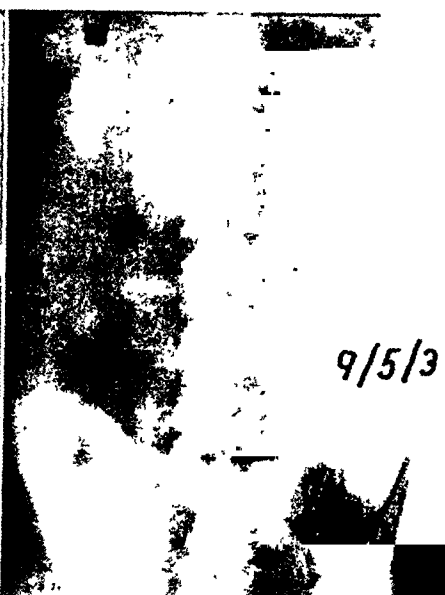
FIG. 5B. Anteroposterior roentgenograms of lumbar spine of A. C., September 5, 1939, showing the degree of postoperative reduction.

big toe, the dorsum of the second, third and medial half of the fourth toes of the left foot are still hypesthetic.

The position and condition of the involved vertebrae at the present time is shown in Figures 12A and 12B. In the lateral view (Fig. 12A) the backward displacement of the upper on the lower segment is even more noticeable than in Figure 7A. Hypertrophic bone anterior to the bodies of L 1 and L 2 bridges these two vertebrae. In the anteroposterior view (Fig. 12B) hypertrophic bone, more abundant on the right than on the left, is seen at the lateral sides of the involved vertebrae, extending continuously between them. A slight lateral displacement to the right of L 1 on L 2 has occurred.

DISCUSSION AND SUMMARY

Fracture dislocation of the thoracic and lumbar spine with cord or cauda equina involvement, although not common, is by no means rare.[2,8] Even though there is no evidence of cord or root pressure immediately following the accident, paralysis may develop as a result of treatment, a circumstance experienced by Rogers[6] in

Since the four cases in which cord involvement followed manipulation showed either a crushing fracture of the posterior wall of the vertebral body or fracture dislocation, Rogers divides his cases from the standpoint of cord hazard into two groups: the safe and the dangerous. In the safe group he includes all vertebral body fractures which do not involve the posterior wall of the centrum, probably over 90 per cent. The dangerous group includes all dislocations and all fractures involving the posterior wall of the centrum.

In the case reported by Rogers[6] in which open surgical reduction was performed there had been little or no evidence of root pressure for a day after the accident. "Slowly spreading paralysis then developed in scattered groups in both lower extremities. On the third day during an attempt to effect extension by the usual method of using ankle traction and suspension with block and tackle supplemented by manual traction, the paralysis quickly changed to complete paralysis. Open reduction under local anesthesia was done the same day.
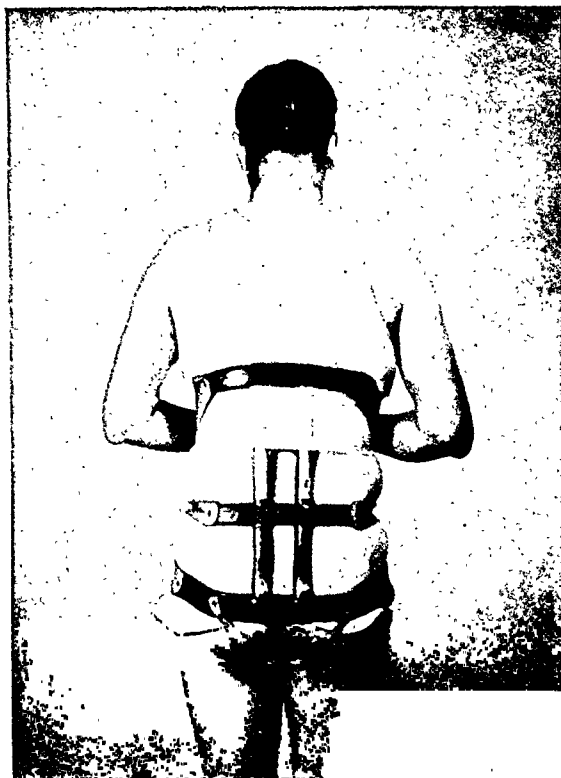
Fig. 6a. A. C., back brace being worn, nine months after operation.
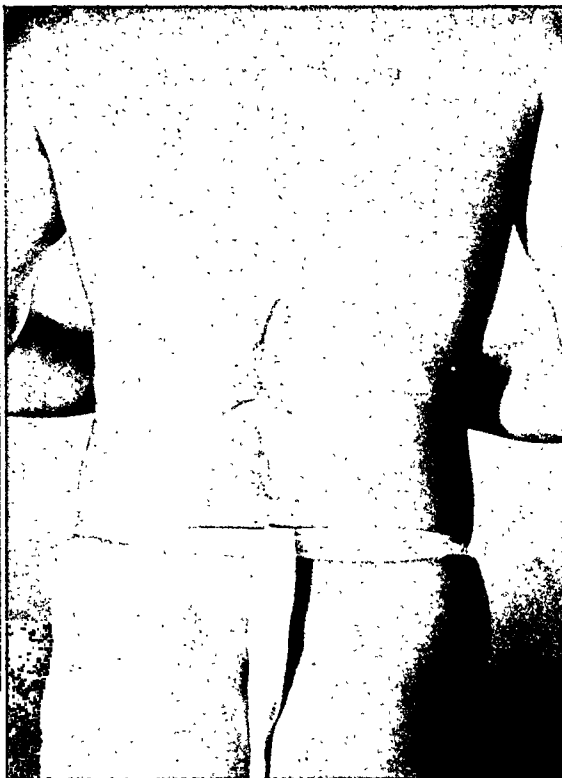
Fig. 6b. A. C., position and condition of operative incision nine months after surgical reduction of fracture dislocation.

Fig. 6c. A. C., degree of forward bending of the spine possible nine months after surgical reduction of fracture dislocation.

Fig. 6d. A. C., nine months after surgical reduction of fracture dislocation; muscular power of right leg, though still weak, can support body weight when knee is flexed.

One year later all neurological signs had cleared up, the patient was symptom free and able to engage in full pre-injury activities."

gave but a temporary feeling of success, however, since roentgenograms made the following day (Figs. 4A and 4B) showed that although the compression fracture of

FIG. 7A. Lateral view.

FIG. 7B. Anteroposterior roentgenogram of lumbar spine of A. C., May 31, 1940, to show condition and position of L 1 and 2 nine months after open surgical reduction of fracture dislocation.

In the case of A. C., whose record forms the basis of this communication, damage to the spinal contents at the time of the accident was evident on admission to the hospital. During the subsequent four hours the paralysis gradually extended to involve both lower extremities. Except for a sensation of coldness, the right leg became completely paralyzed, the right half of the peroneum anesthetic. Hypesthesia in the left inguinal region of the front of the left knee and on the dorsum of the left foot was also noted.

Circumstances were most unfavorable for open reduction at this time, but the need for relief was imminent. An attempt by the usual method of ankle traction and manipulation, a few hours after the injury, resulted in a complete disappearance of all external evidence of the deformity. The symptomatic relief which also followed

the body of the second lumbar vertebra as well as the forward displacement of the upper on the lower segment had been favorably affected by the procedure, (Fig. 4A) the lateral dislocation had become securely locked by a change which had occurred in the positions of the articular processes of the involved vertebrae. (Fig. 4B.)

Even though the attempt at closed reduction failed in complete restitution of the displaced parts (Figs. 12A and 12B), the symptomatic relief thus obtained did permit an extension of time to procure more favorable conditions for open reduction nine days after the injury.

Although recovery cannot yet be considered as complete, since there is still some weakness evident in the lower left abdominal muscles as well as areas of hypesthesia in the left inguinal region of the front of the

left knee and of the medial four toes, the patient resumed practically all of his pre-injury activities within the year following his injury.

CONCLUSIONS

1. A favorable outcome can be expected from open surgical reduction of fracture dislocation of the lumbar spine with cord or cauda involvement if the injury to the spinal contents has not been so great as to cause irrecoverable cord damage.

2. Complete reduction affords the best chance for satisfactory recovery even in those cases in which the damage to the spinal contents appears to be extensive.

3. Careful consideration should be given to the condition of the articular processes of the involved vertebrae in all fracture and fracture dislocations of the thoracic and lumbar spine. If the processes are locked in a dislocated position, open operative reduction should be done as soon as the patient's condition will permit doing so with safety.

4. If it is apparent that the articular processes might lock on extension, great care must be exercised in any attempt at closed reduction, and should not be resorted to except when the need for reduction is imminent and circumstances will not permit open reduction.

5. Even when no evidence of cord or root pressure is present immediately following the accident, the development of paralysis, either immediate or delayed, in the dangerous cases[6] can be avoided by open reduction.

6. It is conceivable that the removal of one or more of the involved articular processes may be necessary to facilitate reduction, but their retention when practi-cal should aid in the stability of the parts once reduction is accomplished.

7. Because of extensive damage to soft structures which normally retain the vertebrae in position, measures to prevent redislocation, particularly the slipping backward of the upper on the lower spinal segment, should be instituted and continued until healing is secure. In the case here reported a piece of surgical wire passed through the spinous processes together with a posterior shell proved practically adequate for this purpose, but did permit some displacement as evidenced by the roentgenograms. (Figs. 12A and 12B.) (A strong absorbable suture and a well applied body cast may have served better to prevent the slight redislocation which did occur; this would also have avoided the additional operation for the removal of the wire suture.)

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PAPILLARY CYSTADENOCARCINOMA OF THE OVARY*

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EPHRIAM McDOWELL opened the field of abdominal surgery when he removed an ovarian tumor from a woman in 1809. This was done on the kitchen table in his home at Danville, Kentucky. Since this notable operation, there have been many abdominal explorations in which the chief object has been to investigate and remove, if possible, tumors of the ovary. There are numerous types or kinds of such tumors and many different ways of classifying these new growths, but this paper is to consider only one tumor of the ovary, namely, the papillary cystadenocarcinoma. This term is a descriptive one used by the majority of men in referring to this type of tumor and is perhaps the best known of the names for it. As used in this paper it includes the papillary adenocarcinoma and the carcinomatous cystadenoma, papillary and mixed, of Broder's classification as listed by Counseller and Desjardins.[11]

It is not the purpose of this paper to reclassify this tumor or to try to fit it into any one of the numerous classifications of ovarian tumors. It is, rather, purposed to discuss papillary cystadenocarcinoma of the ovary, stressing in particular the treatment.

For the purpose of investigation and study, the records of the Guthrie Clinic and Robert Packer Hospital have been used, going back to June 1, 1927. There have been thirty cases of papillary cystadenocarcinoma which can be used in this study. Only those cases are reviewed in which there was a definite pathological diagnosis made on evidence as shown by operation or necropsy including microscopic verification. There were other cases in the files with a clinical diagnosis of papillary cystadenocarcinoma which lacked pathological diagnosis because they had not as yet come to operation or necropsy. For this reason they were not included in the present series.

ETIOLOGICAL FACTORS

Papillary cystadenocarcinoma of the ovary arises from epithelial structures found within the ovary. Goodall[15] has shown that the ovary contains many of these epithelial structures, all of which are derived from a common source—the germinal epithelium. Counseller[9] speaks of these as undeveloped cells and embryonic rests, showing that they arise from the surface of the ovary. Because nothing in the human body can equal the metaplastic powers of the germinal epithelium and because the ovary undergoes numerous physical changes from puberty to the menopause, it is not hard to understand why it is such a common seat of malignant change. However, it is more difficult to understand in some cases why it assumes the papillary type of growth with which we are interested in this paper.

Taylor[36] in a study of malignant tumors of the ovary, describes two methods for the formation of the papillary growths. The first is a simple sprouting of the epithelium which carries connective tissue and blood supply with it. The second method is by the formation of multiple glands which dilate until the partitions rupture. Broken ends thus form projecting papillae. The first may be of any size and usually has a cauliflower-like appearance with a small base or pedicle. It is this type which projects on the surface of the tumor in some

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* Cases taken from the records of the Guthrie Clinic and Robert Packer Hospital, Sayre, Pennsylvania.

cases. The second is more strand-like and is usually found on the inside of the tumor.

Bernstein,[3] in a study of over 1,000 cases of operations for ovarian tumors, has shown that papillary cystadenocarcinoma is the most frequent type of malignancy of the ovary. In general this agrees with the observations of other workers although his figure of 85.5 per cent is much higher than that found in the other groups of cases. Bernstein[3] shows that of all new growths of the ovary, benign and malignant, 15 per cent are papillary cystadenocarcinoma. Taylor[36] says that approximately one-half of all serous epithelial tumors of the ovary are papillary in nature and one-half of these are malignant.

In 245 cases of papillary cystadenocarcinoma, Moench[25] found the average age to be 46.9 years; in his series the oldest was seventy-three years and the youngest sixteen years. Only twenty-nine of his group were single but of the married women there were seventy-three who had no children so that the nonparous group totaled 102 patients or 40.2 per cent and the parous group 152 or 59.8 per cent. These figures may well be taken as representative of this type of tumor. Bell, Blair, and Datnow[2] also showed that the majority occur in parous women. They group the largest number of ovarian neoplasms between the ages of twenty-four and fifty years and speak of this as the "period of reproductive involution." It is at this time in life that there is perhaps the most marked change in the structure and function of the ovaries. If the metaplastic powers of the epithelium are going to manifest themselves by producing a new growth, it would be most likely to come at this period. In the thirty case histories reviewed here, it was found that the ages vary vetween thirty-one and seventy-seven with an average age of 52.9 years. Table 1 shows the grouping of these.

Many have said that there is no definite relation between carcinoma of the ovary and other carcinomas. While it is true that there may be two lesions, both malignant, in one individual, this does not often occur.

It is interesting that in this small group of thirty cases there were five patients or 16.6 per cent who either had or have had a carcinomatous lesion elsewhere in the body. There were three cases with carcinoma of the breast. Two of these patients had the breast lesion at the time the ovarian pathology was found. The other patient had had a radical mastectomy for carcinoma five and one-half years previous to the finding of the pelvic pathology. Of the other two patients with carcinoma elsewhere, one had had surgery for "carcinoma of the bowel" seventeen years previous and in the other an adenocarcinoma of the rectum was discovered one month after operation for the papillary cystadenocarcinoma. In spite of the presence of three breast carcinomas in this group it is believed that there is no relation between papillary cystadenocarcinoma of the ovary and carcinoma of the breast.

TABLE 1
AGE GROUPS

Ages Years	Number	Per Cent of Total
30–39 incl.	3	10
40–49 incl.	5	16.6
50–59 incl.	15	50
60–69 incl.	5	16.6
70–79 incl.	2	6.6

Racial incidence seems to point to the greatest number of these cases being in the white race but no definite figures were found to substantiate it. All of the cases in this Clinic were in white females but the area from which the patients were drawn has a much smaller colored population than many other areas.

SYMPTOMS

The complaints of these patients are mild and insidious in onset. It is for this reason that so often the patients are first seen in a late stage of the disease. Were the symptoms more severe or were there more definite changes in the menstrual periods of

these patients, a larger number would seek medical care earlier. The earlier it is diagnosed, the better the prognosis because the condition is more likely to be operable.

It is startling to find that a tumor as large and as rapidly growing as papillary cystadenocarcinoma does not produce more symptoms. The rapidity of growth and the fact that it is a fairly movable tumor occurring in the abdomen of the female, which physiologically is capable of taking care of an enlargement of the pelvic organs as in pregnancy, may have some bearing on the comparative lack of symptoms. Then again it is true in general that until far advanced, a carcinoma may not have many symptoms. However, with a tumor of an organ so intimately connected with menstruation, one might expect more of a change in the menstrual history.

The majority of patients, when first seen, will complain of lower abdominal distress. It is usually unilateral but may be in the midline or bilateral. While in most patients the pain is not severe, there are a few who complain of a severe, sharp stabbing pain. Moench[25] stated that 52 per cent have pain of some type and that it is the most common symptom of which the patient speaks. Bernstein[3] found that 65 per cent of patients complain of some type or degree of abdominal distress and speak of the pain as fairly constant but mild, being not as common in carcinomatous as in benign growths of the ovary. The pain is due to general abdominal pressure, change in the ovary itself and interference of the blood supply but may be caused by pressure of the new growth on other organs and by the pull of adhesions. Adams[1] found that acute pain is usually associated with torsion, necrosis or rupture. In more advanced cases the pain can often be attributed to peritoneal irritation.

In the case histories reviewed in this Clinic, it has been found that 66 per cent of patients had some type of abdominal pain. Some patients did not at any time have even the slightest distress in the abdomen but came for other symptoms such as swelling and fullness or because they had noted enlargement of the abdomen.

In some of the patients the interference with ovarian function is indicated by a change in the regularity or amount of menstrual bleeding, but when present these changes are usually slight. After the menopause there may be a small amount of bleeding or spotting at irregular intervals. Metrorrhagia is present in only a few patients. Because such a large number of patients are beyond the menopause, the percentage of irregularity of menstrual bleeding is much smaller than were one to compute statistics only on those who are premenopausal. In this series of cases there were twenty-three postmenopausal patients and only seven premenopausal. Fifty-seven per cent of the seven in the premenopause group showed irregularity but this is only 13.3 per cent of the whole group. On the other hand there were 30.4 per cent of the postmenopausal group who showed some evidence of bleeding again; this is 23.3 per cent of the series. Altogether one-third of the patients complained of irregularity or spotting. Berstein[3] found only 4 per cent of papillary cystadenocarcinoma to have spotting or bleeding after the menopause.

TABLE II

MENSTRUAL CHANGES—IRREGULARITY OR SPOTTING

Group	No. Cases	No. Showing Changes	Per Cent of Group	Per Cent of Total Cases
Premenopause	7	4	57.0	13.3
Postmenopause	23	–	30.4	23.3
Total cases	30	11		36.6

When first looking over these cases the age of onset of menstruation was thought to be of some possible significance. However, it was later found that the average age of onset was 13.7 years. Only two began menstruating after the age of fifteen years. Lynch,[24] in making a study of ovarian cancers, found that 30 per cent of ninety-two patients with carcinoma of the ovary

did not begin to menstruate until fifteen years or later. The average age in his group was 13.9 years. He studied normals in gynecologic patients by taking nine groups of 100 cases each and found that from 15 to 35 per cent of the patients began menstruating at fifteen years or later. The average for the nine groups (900 patients) was approximately 28 per cent starting at fifteen years or later. With these normals in mind one cannot attach any significance to the age of onset of menstruation.

Backache is a rather common symptom but is so common in many of the pelvic disorders of women that no clinical significance can be given to it. Those patients in whom there is considerable enlargement of one or both ovaries seem to have more of this discomfort than the other patients.

Some patients may have been conscious of a mass for weeks but had not sought relief until a more sudden diffuse abdominal enlargement was noticed. The onset of metastasis can often be judged by this sudden enlargement of the abdomen due to ascites. Because of its significance, it is only too frequently found. However, not all patients with fluid will have metastases to the peritoneum, nor will all patients with metastases show fluid in the abdomen.

The weights of the patients in this series were not recorded in all instances nor was a change of weight mentioned frequently. In seven patients there was a definite history of weight loss but this was late in the course of the disease as shown by operation. Associated with the weight changes was some degree of general malaise and ill feeling.

Other symptoms such as bladder irritation and respiratory complaints are infrequently seen. These can usually be attributed to direct pressure by the tumor mass as it enlarges or by the general abdominal pressure of ascites. The bladder symptoms of dysuria, frequently and urgency are usually mild.

Gastric symptoms such as anorexia, nausea and vomiting occasionally do occur. The anorexia usually accompanies the malaise and other general symptoms.

FINDINGS AND DIAGNOSIS

The findings on physical examination associated with the history and the symptoms will lead one to make a diagnosis of carcinoma of the ovary. However, the distinction between papillary cystadenocarcinoma and other malignancies may be more difficult. All malignancies of the ovary are not as rapidly growing as is this condition. A rapidly growing tumor with a short history associated with bilateral involvement and ascites might well be diagnosed as papillary cystadenocarcinoma.

There will usually be a palpable, somewhat tender mass in one or both lower quadrants on abdominal examination. On vaginal examination, the occurrence of a mass is constant. It is usually found separated from the uterus and in early cases is movable, later becoming fixed. It may be smooth and rounded but most commonly is nodular and irregular. It rises well up out of the pelvis to a level of the umbilicus or above. Often the involvement is bilateral. A very early involvement and one which is not frequently seen may show a little enlargement of only one ovary. Occasionally, one will find a generalized carcinomatosis with the pelvis filled with a large fixed mass in which no organs are definitely palpable. In these cases there is usually a great deal of omental and peritoneal involvement and nodules can be felt throughout the abdomen. The uterus in the average case is unchanged except for some displacement. Of the histories reviewed in this Clinic 100 per cent showed some degree of pelvic mass either on pelvic or abdominal examination or both.

In the majority of cases there was evidence on examination of bilateral involvement yet in a few of these it was found at operation that the one ovary had extended across the midline, the other not being grossly involved. Vaginal examination often clears up unusual abdominal findings. Clinically, one cannot always say that there is or is not bilateral involvement. Postoperative examination of the clinically uninvolved ovary will often reveal small

papillomas, microscopically demonstrating malignant cells.

Ascites will often mask the findings on abdominal palpation and make the pelvic structures hard to feel on vaginal examination. When present in association with a pelvic mass, it points quite definitely to malignancy with peritoneal metastasis. Boyd[5] points out that bloody ascitic fluid in a female should always suggest the possibility of carcinoma of the ovary. Abdominal paracentesis should be done so as to picture more clearly by palpation the condition of the pelvic organ. A specimen of the ascitic fluid should be sent to the laboratory for microscopic study. A positive diagnosis of malignancy is made if the malignant cells are found in the centrifuged specimen. When present they rule out ascites of nephritis, hepatitis or cardiac failure.[7]

Peritoneoscopy may prove to be of some value in diagnosing obscure cases in which the patient either refuses surgery or is in no condition to stand an operative procedure. In some selected cases it could be used to determine the advisability of roentgenotherapy before a major surgical procedure. Ruddock[32][33] made the diagnosis forty-four times in a series of 900 peritoneoscopies done for various conditions.

Other findings and studies are of little additional help except to inform the examiner of the exact physical condition of the patient. The blood count is practically unaltered except for a frequent elevation of the leukocytes. In those patients giving a history of malaise and loss of weight there is usually a moderate degree of secondary anemia. Norris and Vogt[29] summarize the important symptoms of malignancy as ascites, rapidity of growth, bilateral involvement (50 per cent), fixation of the mass, nodular feel and general symptoms of loss of weight, anorexia and cachexia.

Frost[14] has reported the case of a patient in whom there was found a generalized carcinomatosis but no primary lesion could be demonstrated until eventually a growth in the pelvis became distinct and the diagnosis of papillary cystadenocarcinoma was made and later proved by necropsy. Usually, however, the primary lesion is detected even in the presence of metastasis.

PATHOLOGY

This lesion represents one in which there may be varying degrees of malignancy. Most pathologists agree that some types of papillary cysts of the ovary are not malignant. Again it is not the purpose of this paper to go into detail on the discussion of this point. All the cases reviewed are malignant papillary growths. However, various authors believe that those growths which appear to be benign will also contain some malignant tissue. If it were possible to make serial sections of all these tumors and study them carefully, there would be a larger number of the seemingly benign growths which would be found to be malignant. Taylor[36] says that ovarian cysts, even when believed to be benign, must be tentatively regarded as precancerous and removed as soon as possible, for papillary processes may be on the inside or on the point of developing. Counseller and Desjardins[11] in a review of all adnexal cysts and neoplasms state that "if the cyst [cystadenoma of the ovary] contains papillary growths, it is definitely malignant." Hawk[16] is of the same opinion. Norris and Vogt[29] state that "of benign tumors a definite proportion, particularly of the cystadenoma, would have become carcinomatous if removal had not been undertaken."

Papillary cystadenocarcinoma grows rapidly and metastasizes early. It is much more likely to be bilateral than any other ovarian tumor. Pfanenstiel, as quoted by Taylor[36] says that 66 per cent of papillary malignant tumors are bilateral. Prentice[31] suggested that the contralateral ovary should be examined in every case of papillary cystadenocarcinoma for it is known that different grades of malignancy may be found on the two sides when two cysts are present. In this Clinic it was found that 53.3 per cent of patients had a bilateral involvement.

Grossly, the tumor may have a rough or smooth surface which is multicolored, usually of a pinkish-grey color but it may be whitish, reddish or yellowish exhibiting a wide range of histologic structure. Single tumors vary from adenomatous to almost solid and often mucinous[34] tumors but all show papillary growths at some point. The papillomas may project from the surface or on the inside of the tumor. When on the surface, they give a rough appearance to this portion of the tumor. In type, they may be either a simple papilloma or friable, cauliflower-like and easily broken off. The papillomas often are not noted until the tumor is sectioned.

TABLE III
SIDE OF INVOLVEMENT

Side	Number	Per Cent of Total
Right	10	33.3
Left	4	13.3
Bilateral	16	53.3

The cyst contains fluid or mucinous material, usually of a clear straw color but may be darker and more like the chocolate cysts. These cysts enlarge rapidly soon becoming so large and so fixed as to be inoperable, the tendency to attach early to adjacent structures leading to the difficulty of operative removal. Early metastasis is the rule. According to Codman[8] this occurs when terminal cells drop off and seed the peritoneum. The process may be speeded up by trauma which ruptures the cyst, spreading large numbers of cells throughout the whole peritoneal cavity. Intestinal peristalsis may also do this.[7] Bell and Datnow[2] have demonstrated that even adhesions may carry out malignant cells to other structures.

The usual sites of metastasis are to the opposite ovary and adjacent organs; metastasis to distant organs is rare. Stout[35] says that there is metastasis, peritoneal or distant, in 90 per cent of cases, late metastasis being the exception and not the rule. He has found supraclavicular nodes with metastasis fifteen years after removal of both involved ovaries, metastasis in the spleen twenty-five years after and in the omentum sixteen years after. In addition he has found metastasis in liver, lung and stomach. Other authors have demonstrated metastasis in paravertebral nodes, axillary nodes and ribs as well as other bones. Bernstein[3] pointed out that approximately 50 per cent of papillary cystadenocarcinoma invade the gastrointestinal tract, 60 per cent the peritoneum and 35 per cent the gynecological tract. He stated further that 75 per cent have already invaded secondary structures before surgery.

Recurrence of papillary cystadenocarcinoma is common. Ewing[13] shows that this occurs in 83.3 per cent of cases. Ascites is common and follows peritoneal irritation. About 60 per cent of patients will show ascites in a large series of cases. In the group reviewed from this Clinic there were nine, or 30 per cent, who had clinical evidence of ascites.

Following roentgenotherapy in inoperable cases the tumor is usually found to be decreased in size though not greatly changed in appearance. It tends to be more friable in character and lacks the large cystic areas, although the cystic nature of these tumors is still easily recognized.

Microscopically, these tumors of the ovary present the usual picture of malignancy. At times the definite papillary structure can be seen on the slide by low power as an irregularly proliferating papilla lined by an atypical epithelium which in places consists of several layers.[12] (Fig. 1.) More often the papillary nature is not seen on the slide because of the area in the tumor from which the section is taken or because the papillae are so large they can be sectioned only in part. Under high power magnification the atypical arrangement is more evident and there is no regularity of the cell layers. As in any malignant specimen, mitotic figures will usually be seen. Because it is hard to see the papillary nature from the single slide, one must also depend upon

the gross findings to make the pathological diagnosis. It is well to stress that, with malignancy, cells from ascitic fluid must be stated, these tumors grow rapidly and unfortunately the patient often comes so late in the course of the disease that the condi-
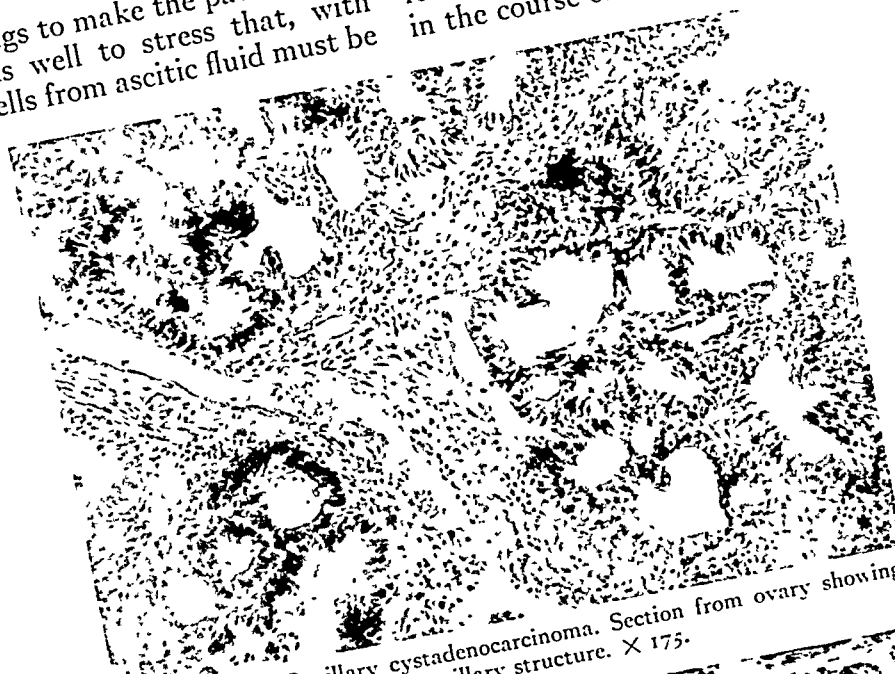
FIG. 1. Case V. Papillary cystadenocarcinoma. Section from ovary showing typical papillary structure. × 175.
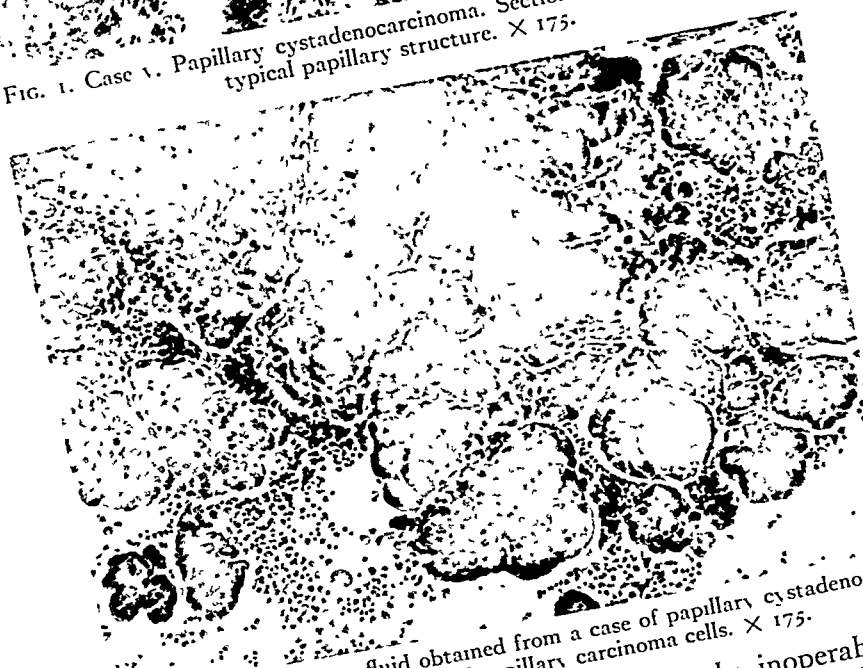
FIG. 2. Case IV. Ascitic fluid obtained from a case of papillary cystadenocarcinoma showing group of papillary carcinoma cells. × 175.

in groups; otherwise they may be confused with epithelial cells. (Fig. 2.)

TREATMENT

As in the majority of new growths the ideal treatment of this condition is early removal before metastasis and direct spread have taken place; but, as has already been tion is already inoperable. The problem then is to do the most that is possible for the patient.

The treatment in this Clinic is in general the same as that followed in many other clinics and by various individuals. An abdominal exploration is done in the case of a patient who is believed to be operable

when first seen. All the pelvic generative organs are removed with the tumor if possible. Following healing of the operative site, the patient is given a course of roentgenotherapy.

In the case which proves to be inoperable at the time of exploration the abdomen is closed and roentgenotherapy started as soon as healing takes place. If good results are noted due to the radiation and the size of the mass decreases, this patient is subjected to a second laparotomy. Following this, another course of roentgenotherapy is given.

If the tumor is considered inoperable on clinical examination, an attempt is made to secure from ascitic fluid (if present) enough sediment to examine for malignant cells to confirm the clinical diagnosis of malignancy. In these patients roentgenotherapy is used first and an operation planned for a later date if the results are satisfactory. Here again a second course of therapy is given following the operation. It is believed that all cases of papillary cystadenocarcinoma of the ovary should have the benefit of radiation.

Other factors preventing surgery are marked cachexia or complications which might endanger the life of the patient on the operating table or during the postoperative convalescent period. With the use of safer anesthetics administered by skilled anesthetists, the number of patients in this group is greatly reduced and more of them can be safely operated upon.

As stated before, all the pelvic generative organs should be removed. At the time of operation a frozen section is made and studied so that the diagnosis is certain before the abdomen is closed. Taylor[36] advises hysterectomy with removal of both tubes and ovaries even though only one side is visibly involved. He also stresses postoperative radiation and says it should never be omitted in any malignant case and that in moderately advanced inoperable cases it may render them operable. Counseller[9] recommends that because of the high incidence of bilateral involvement all the

generative organs should be removed. Kaplan[19] found that the best results are achieved by roentgenotherapy followed by operative removal of the bulk of the tumor and then followed by another course of roentgenotherapy. Murphy[27] urges a judicial use of a combination of surgery and radiation and recommends that ovaries, tubes, broad ligaments and the uterus be removed even in the reproductive period of life. Blair, Bell and Datnow[2] do a total hysterectomy in parous women and a subtotal in the nonparous women and believe that it is disastrous to remove only the one affected ovary and leave in the other ovary, tubes and uterus. Keene,[20] Widmann,[37] Jacobs,[17] and Jacobs and Stenstrom[18] all believe that radiation is justified either after, or before and after operation.

Counseller and Desjardins[11] recommend 2,500 to 3,000 roentgen units through each of four portals or 10,000 to 12,000 units for a total dose. At the University Hospital in Philadelphia the dosage has been given at 200 kilovolts and four milliamperes at a 50 cm. focal skin distance with 0.5 mm. of copper and 2 mm. of aluminum, each treatment lasting from 75 to 100 minutes.

In this Clinic radiation is given at 200 kilovolts and 25 milliamperes, at a 50 cm. focal skin distance with 1 mm. each of copper and aluminum filtration. Approximately 300 roentgen units are given at each treatment. The exact total dosage is determined by the findings in each individual case and by the changes noted or results obtained with this therapy. The average case will receive from 4,000 to 6,000 units or more over a two to four weeks' period.

Treatments are given through four or six portals, four anterior in the four abdominal quadrants and two posterior. The pelvis usually receives the greatest amount of radiation through two anterior and two posterior portals; but if there is extensive upper abdominal metastasis, the two upper portals will receive proportionately more therapy. The portals used are 15 by 15 cm. in size for the average patient but may be varied according to the size of the indi-

vidual. Jacobs and Stanstrom[18] use fields of 350 to 500 sq. cm. anteriorly from the symphisis to the xyphoid and 200 to 300 sq. cm. posteriorly from the coccyx to the last rib.

Treatments here are given over a number of days and in the small daily dosage of 300 roentgen units, as it has been found by roentgenologists that this is less conducive to radiation sickness. Elixir of phenobarbital as a sedative three times a day will go far in combating this sickness if it occurs.

Radiation is begun about two to three weeks after operation, the operative site being well healed, or immediately after diagnosis has been established if no operative procedure is undertaken. During the series of treatments the white blood count should be closely watched though there is seldom an alarming change resulting from this type of treatment.

Keene and Pancoast[21] believe that it is impossible to predict the effect of radiation in any given patient. Some of the most hopeless cases with little radiation will clear up surprisingly while other much less advanced cases may not be appreciably affected by an enormous dosage. They feel that the peritoneal metastases are more sensitive to radiation if the primary growth has been removed. Bevan[4] says that "as a rule of course, in these ruptured papilloma with peritoneal implants, x-ray therapy is not successful and the patient goes on to fatal termination." Others find that often there are good results shown by decrease in the size of metastatic nodules and less rapid formation of ascitic fluid. It is true, too, that at times the metastatic nodules will disappear after removal of the primary tumor even without radiation.

Stewart[34] finds that lower grades of malignancy in papillary cystadenocarcinoma yield better results after radiation. Perry[30] states that if ground is gained slowly, the effect is more lasting than in those cases with rapid and startling early progress following radiation.

Patients in this Clinic who have had roentgenotherapy before operation are fol-lowed closely and examined frequently so that removal of the tumor may be attempted at the most satisfactory time during the patient's response to therapy. When ascites is present, abdominal paracentesis is done as frequently as necessary. The general physical condition of the patient is also closely checked and improved as much as possible. Transfusion is given if there is much lowering of the hemoglobin and red blood cell count. Other more general methods are used to build up the health of the patient.

PROGNOSIS

As with any highly malignant lesion the prognosis in papillary cystadenocarcinoma is extremely guarded; it is usually fair if the primary or parent growth is removed. Counseller[9,10] believes that 50 per cent survive five years after panhysterectomy with radiation and deep roentgenotherapy. Moench[25] found in 231 cases traced three years or more after operation that there were 27.1 per cent of deaths and all these were due to abdominal recurrence or distant metastasis. Of the 168 living patients, six had been followed for three years, ninety-seven for five years and sixty-five for ten years. In her series there were only forty-eight cases that showed metastatic growths. Taylor[36] gives the prognosis as being fair if only one ovary is involved when operated upon and more hopeless if both ovaries are diseased. If limited to the removable pelvic organs, 44.1 per cent have a fair chance. Other cases are all hopeless.

TABLE IV
SURVIVALS AT VARIOUS YEAR PERIODS

Years after Operation	No. Patients	Per Cent of Total
Less than 1	13	43.3
1	17	56.6
2	13	43.3
5	7	23.3
7	5	16.6

We have been able to follow all of our thirty cases reviewed and have examined or

have received a report of examination on all the living patients during the months of October and November, 1939. Tables IV and V show the distribution of the patients after surgery.

TABLE V

YEARS SINCE OPERATION OF 11 LIVING PATIENTS

Years since operation	1	2	3	4	5	6	7	8
Number patients living	1	3	0	1	1	0	3	2

One patient is still living nearly nine years after surgery. All of the cases studied have been proved by observation of the lesion and microscopic study of tissue removed and in each case a diagnosis of papillary cystadenocarcinoma was made. An effort was made to correlate the physical findings at time of examination with the findings at the time of operation and it was found that in almost all cases the lesion was found to be about as one would imagine from the physical examination. However, in several instances the lesion was thought to be unilateral but at operation it was found that there was extension into the other ovary.

CASE REPORTS

The case histories of five of the patients are presented in more detail:

CASE I. A white female aged forty-four years, married for twenty years, primipara and premenopausal, came to the Clinic with the chief complaint of abdominal swelling and a feeling of fullness for ten days. Associated with this was some moderate pain across the lower abdomen, with frequency and nocturia. The menstrual history was negative, the last period occurring two weeks before admission. Routine laboratory studies were normal. Abdominal examination showed only a marked ascites. Vaginal examination revealed a large, nodular, tender, hard, fixed mass in the right adnexa and midline. A diagnosis of papillary cystadenocarcinoma was made but it was believed that the condition was inoperable so that roentgenotherapy was advised as a preoperative measure. A total dose of 7,800 roentgen units was given in twenty-six treatments. During the time of these treatments

abdominal paracentesis was performed eleven times. Each time the interval between was longer until toward the end of the treatments the fluid ceased to accumulate. Examination of the pelvis at intervals showed a marked decrease in the size of the tumor in the pelvis although nodules had appeared in the upper abdomen.

Eight months after first being seen in the Clinic an abdominal exploration was performed as it was thought that the condition had now become operable. In the area of the right ovary was a moderately sized, friable mass which was removed with some difficulty. Frozen section at this time showed malignant cells and the papillary nature of the tumor was evident. There was some involvement of the left ovary also and permanent sections of the mass and the left ovary showed papillary cystadenocarcinoma. The operation consisted of bilateral salpingectomy and oöphorectomy, subtotal hysterectomy and excision of metastatic growths in the omentum. A large portion of the omentum was removed with these growths.

Two weeks after surgery she was again given roentgenotherapy consisting of a total dose of 6,000 roentgen units in twenty treatments with a proportionate amount to the upper abdomen because of the metastatic growths that had been found there at the time of surgery. Three and one-half months after operation there were still some nodules palpable in the upper abdomen and more roentgenotherapy was advised, 3,180 roentgen units being given through two upper abdominal portals at this time. There was fluid still forming in the abdomen which required draining at intervals until the time of her death at home eight months after surgery.

CASE II. A white female, aged fifty-one years, married for thirty-one years, gravida IV, para IV and five years postmenopausal, came to the Clinic because of a sharp pain in the lower abdomen radiating into the labia. This had continued for six or seven weeks during which time she had also noted a palpable tumor low in the abdomen. She had lost thirty pounds during the previous three months. There had been no postclimacteric spotting or bleeding. Routine laboratory studies were normal except for a slight elevation in the white blood count with a normal differential, and one plus pus cells in the urine. On abdominal examination there was some tenderness across the lower

abdomen and a mass was palpable in the lower right quadrant rising nearly to the level of the umbilicus. On vaginal examination the uterus was felt to be separate from a large mass which filled the right adnexa. This mass was fairly firm and not movable.

Exploratory laparotomy was advised and was performed two days after admission. At operation there was found a large fixed ovarian cyst on the right side with metastatic papillary areas in the peritoneum, the small bowel was adherent and the mass itself was fixed to the posterior wall. A biopsy was taken and the abdomen closed. Frozen and permanent sections showed a papillary cystadenocarcinoma, grade III. Roentgenotherapy was started after healing of the abdominal wound and a course of twenty treatments were given with a total of 6,000 roentgen units. There were four treatments to each of four pelvic portals (two anterior and two posterior, 15 by 15 cm.) and two treatments to each of two anterior upper abdominal portals. During the last stages of treatment fluid began to collect in the abdomen requiring abdominal paracentesis six times at ten day intervals removing from four to eight liters each time. The fluid gradually became more reddish and cloudy. During these two months the general condition of the patient became worse and she died seven months after first being seen. A necropsy was not obtained.

CASE III. A white female, aged fifty-five years, married for thirty-seven years, gravida VI and para VI, and eight years postmenopausal, came to the Clinic because of protruding abdomen which had become larger during the preceding year. The family physician had noted a tumor in the abdomen. She had noted no spotting or bleeding since the menopause. Routine laboratory studies, (urine and blood counts) were normal and the Wassermann test was negative. On examination she had some moderate tenderness over a large lower abdominal mass extending up to the costal margin on the left side. No ascites was noted. Pelvic examination revealed an immovable mass filling the entire pelvis and extending up into the abdomen. The uterus was small and posterior.

Three days after admission an exploratory laparotomy was performed and a biopsy was taken from this irregular mass which was found to be rising from the pelvis and extending upward in the root of the mesentery. Permanent section of the tissue removed showed a papillary

cystadenocarcinoma of the ovary, grade III. Roentgenotherapy was instituted when she had recovered from the operation. Through four abdominal portals, 3,600 roentgen units were given; 1,200 r to each lower quadrant and 600 r to each upper quadrant. Three months later this patient returned for examination. No masses were found and the uterus was movable. Seven months after operation and roentgenotherapy, the pelvis was found to be free of any mass.

One year after operation she returned with symptoms of a transverse myelitis that was thought to be metastatic. She died shortly after coming into the hospital and necropsy was done but no tumor was found in the spine. There were some small metastatic lesions throughout the mesentery but no large masses were found and the ovaries were small and hard.

CASE IV. A white female, aged sixty-nine years, married, gravida IX, para VII, and 29 years postmenopausal, presented herself because of swelling in the abdomen over a period of four to five months. In the previous two weeks the swelling had been more marked and more rapid. She had had no postclimacteric spotting or bleeding until one week before admission when she had noticed a small amount of bloody discharge. During the preceding two weeks she had experienced some lower right quadrant pain of a bearing down nature. Routine laboratory studies were negative. On abdominal examination there was evidence of ascites and a palpable, irregular, rather firm, almost fixed mass in the lower right quadrant. On vaginal examination the uterus and a separate right adnexal mass were fixed.

Abdominal paracentesis was performed the day after admission and four liters of clear, straw-colored fluid were removed, making the mass more distinctly outlined. Microscopic study of a specimen of this centrifuged fluid showed malignant cells in groups. Roentgenotherapy was begun and she received 8,320 roentgen units in twenty treatments through six portals, four anterior and two posterior (15 by 15 cm.). Two months after first being seen in this Clinic and five weeks after the roentgen treatments had been completed, the physical examination showed that the condition was probably operable. Exploratory laparotomy showed both ovaries to be involved. The right was a reddish friable mass and the

left was cystic. There were adhesions to the intestines and a few small metastatic nodules in the peritoneum. Frozen section showed malig-

examination revealed a large, irregular, movable mass in the left side. Physical examination was otherwise essentially negative. It was be-
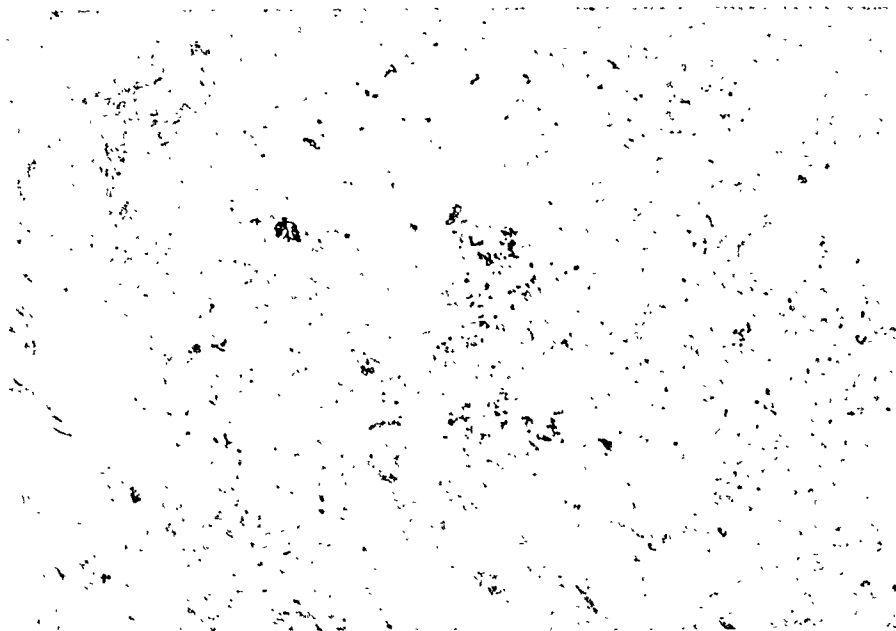
FIG. 3. Case IV. Papillary cystadenocarcinoma. Sections from ovary following roentgen theray showing fibrosis with degeneration of cancer cells. × 175.

nant cells. A bilateral salpingo-öophorectomy was performed but it was impossible to remove the uterus with safety. Permanent sections of the ovaries showed papillary cystadenocarcinoma. Two weeks after surgery another course of therapy was given consisting of a total cinoma. Two weeks after surgery another dose of 4,635 roentgen units in sixteen treatments. Four months after the operation she returned with evidence of ascites. After removing five liters of fluid the pelvic examination revealed some fixity of the uterus but no definite mass was felt; however, the course was generally downward and the patient died with recurrence of the lesion five months after surgery.

CASE V. A white female, aged fifty-nine years, single, nullipara, and fifteen years postmenopausal, presented herself in this Clinic because of a dragging down sensation with pain across the upper abdomen for some months. For four months she had had a rather sharp cramp-like pain in the lower left quadrant and some weight loss although the definite amount was not determined. She had noticed no spotting or bleeding since the menopause. Routine laboratory studies were normal. On abdominal examination moderate tenderness in the midline and lower left quadrant was noted. Vaginal

lieved that this patient had an ovarian cyst which was possibly malignant.

Surgery was advised and at the time of operation a large cyst of the left ovary was removed. There had been perforation of this and a low grade peritonitis was observed, believed to be due to the content of the cyst. The operation consisted of a bilateral salpingo-öophorectomy and secondary appendectomy. The specimen of the ovary showed a multilocular appearance with many papillary growths. Microscopic study of a permanent section showed papillary cystadenocarcinoma, grade II. As soon as the postoperative condition would permit, the patient was given roentgenotherapy. In twelve treatments a total dose of 3,600 roentgen units (900 to each of four abdominal portals, 15 by 15 cm.) was given. Twenty-one months after operation she was again admitted for acute diverticulitis which responded to conservative treatment. At this time there was no evidence of recurrence on abdominal and pelvic examinations.

SUMMARY

The subject of papillary cystadenocarcinoma of the ovary has been considered and the more recent English literature reviewed. Thirty case records have been

studied, five of these being presented in detail.

Papillary cystadenocarcinoma is a malignant tumor which usually metastasizes so early that the condition is far advanced before the patient seeks aid.

The average age at which it occurs is approximately fifty years. It is slightly more common in parous than in nulliparous women.

Pain and a tumor mass are the predominating symptoms and findings. Over 50 per cent are bilateral when treatment is first undertaken. The growth of the tumor is rapid and metastasis is first to the opposite ovary, then to the uterus, peritoneum and other abdominal organs. Recurrence after removal is common.

Malignant cells recovered from the ascitic fluid aid in the diagnosis and also the planning of a proper course of treatment which consists of operative removal followed by roentgenotherapy in the average patient. Surgery should aim to remove all the pelvic generative organs. Radiation should include the entire abdominal cavity. The effect of radiation is not constant in all patients. Following the removal of the primary growth, the secondary growths may disappear of themselves.

The prognosis is extremely poor but should not keep the surgeon from doing all possible to alleviate the patient. Many patients go without recurrence for years after adequate treatment.

Most of the patients from this Clinic that received roentgenotherapy were far advanced at the time of the first examination.

CONCLUSIONS

The number of cases in this series which received roentgenotherapy is too small to draw definite conclusions as to the value of irradiation. However, Case v illustrates what might be classed as a radiation cure. The necropsy findings of Case iii show the effect of radiation on these tumors. Necropsy findings in one other case showed the ovaries to be small and fibrotic, the patient having died from another cause.

Figure 3 shows a section from a similar ovary.

We find that radiation tends to decrease the size of the tumor to the extent that a previously inoperable tumor may become operable.

In those patients in whom the tumor has spread beyond the one ovary at the time of surgery the prognosis is extremely poor, but if the tumor is still confined to the ovary and there are no papillary growths on the surface, the prognosis is favorable following surgery and irradiation.

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IN their earlier stages these growths (ovarian tumors) produce symptoms only when complications arise, i.e., suppuration or twisting of the pedicle. Small, suppurating cysts give practically the same signs as those of a pus tube, and are recognized only at operation or autopsy.

TOTAL HYSTERECTOMY—VAGINAL OR ABDOMINAL?

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NO attempt will be made in this paper to justify the accepted procedure of total hysterectomy. Rather, by a review of the indications, limitations and end results achieved, an attempt will be made to attract renewed interest in the vaginal approach. Because it is either forgotten or ignored in some parts of Europe and the United States it is hoped that this study will not only revive but also increase the scope of this now too little employed operation. It was made from the hospital records of the Rudolfspital of Vienna, Germany, on the service of Dr. Paul Werner, and consists of an analysis of 100 consecutive vaginal and 100 consecutive abdominal total hysterectomies. It does not include either Wertheim or Schauta operations as these cannot be classified as simple total hysterectomies. And although it covers but a relatively small series of cases, its value is enhanced by the fact that these operations were all performed by one man who followed closely a uniform technic.

All of these patients were white. They were drawn from the middle and lower classes in which hard, manual work is the rule and not the exception. Their age distribution is shown in Table I to be nearly alike for both the vaginal and abdominal series. Here, as is true in the United States, most of the hysterectomies were performed upon patients between the ages of forty and forty-nine.

The marital status of these patients shown in Table II requires little comment, other than to explain that Roman Catholic nuns have invariably been operated upon by laparotomy in this clinic even though they could have been operated upon through the vaginal route.

It has long been maintained that it is technically more difficult (it has also been considered a contraindication) to perform a vaginal hysterectomy upon a nulligravida than upon a multipara. This is not altogether true, for in the latter as a result of chronic parametritis the operation may be even more difficult due to difficulties in separating the bladder from the cervix, ligating a shortened hard Mackenrodt's ligament and bringing down the uterus. Also women past the menopause may have a vagina so shrunken that the cervix and uterus appear inaccessible. However, an episiotomy in nulligravida and an incision in the lateral vaginal wall in climacteric women will facilitate the necessary approach.

The question of anesthesia is largely one of individual preference. However, spinal anesthesia effects prolonged deep muscular relaxation desirable when performing a panhysterectomy via laparatomy. Because the hysterectomies in the abdominal series were nearly all difficult to perform due to the presence of extensive adhesions and large tumors, spinal anesthesia was employed in 82 per cent of the patients. On the other hand, vaginal hysterectomies are shorter in duration and do not require such deep muscular relaxation. Therefore, intravenous anesthesia was employed in 81 per cent of the series. There were no anesthesia accidents.

In simple vaginal hysterectomies, i.e., those without removal of adnexa and without adhesions, the peritoneal cavity was closed so that the gauze drain was in the vagina only. When adhesions were encountered and adnexa were removed, the peritoneal cavity was left open. In these cases the gauze drain was introduced to just

within the peritoneal cavity. In abdominal hysterectomies, wherever possible, the peritoneal cavity was closed so that only the subperitoneal space was drained. The

TABLE I
AGE DISTRIBUTION

Age in Years	Vaginal Hysterectomy	Abdominal Hysterectomy
20–29	1	0
30–39	9	11
40–49	56	57
50–59	29	23
60–69	4	5
70–	1	4

Mikulicz's tampon was employed to prevent infection of the peritoneal cavity in which large areas were left raw, rough and denuded of peritoneum following the removal of pus tubes. When absolute surgical

TABLE II
MARITAL STATUS

	Vaginal Hysterectomy	Abdominal Hysterectomy
Married	70	45
Single	10	18
Widow	13	15
Divorced	7	14
Sisters	0	8

control of bleeding and oozing surfaces was impossible, a Logothetopulos tampon was resorted to. One patient was tamponed from above and one from below.

Table VI compares the average number of days spent in the hospital. That average time in days for the abdominal series is greater than for the vaginal series may be accounted for by: (1) the former had more extensive pathology and therefore required more extensive surgery, (2) more than 10 per cent of that series required from ten to forty-five days of preoperative care before surgical intervention could be considered,

(3) postoperative complications developed more frequently. In that series systemic complications played no part (Table VIII). Three patients in the abdominal series re-

TABLE III
PARITY

	Vaginal Hysterectomy	Abdominal Hysterectomy
Parity 0	22	49
Parity +	78	51

quired treatment for shock. In all, 18 per cent of the abnormal series could be described as having run an abnormal postoperative course as compared with 12 per cent for the vaginal series. It can be concluded that those patients from whom it is possible to remove the uterus vaginally can be assured of a smoother convalescence and

TABLE IV
ANESTHESIA

	Vaginal Hysterectomy	Abdominal Hysterectomy
General (open ether)	18	15
Intravenous (eunarcone)	81	3
Spinal	1	82

a shorter stay at the hospital than when it is removed abdominally, an important factor to remember when operating upon women who must return to their work as soon as possible.

Patients are less apprehensive of vaginal work than of abdominal work, and therefore more readily consent to indicated surgical intervention. There is a lower incidence of postoperative tympanites. Patients are more likely to void spontaneously, and in the presence of respiratory difficulties breathe and cough far more easily following a vaginal hysterectomy than an abdominal hysterectomy. These definite

advantages of the vaginal route over the abdominal route cannot be ignored.

Those patients (Table VIII) suffering from systemic disturbances in addition to their pelvic disorders, severe enough to

TABLE V
DRAINAGE

	Vaginal Hysterectomy	Abdominal Hysterectomy
Vaginal	91	83
Logothetopulos .	9	10
Mikuliczs. . .	0	6
Logo. and Mik. combined	0	1

make them poor surgical risks, were given indicated treatment before submitting them to surgery. In the vaginal series four patients were admitted with a past history of adnexitis, one with thrombophlebitis and one with parametritis. In the abdominal series fourteen patients were admitted with a past history of adnexitis, one with a parametritis and one with tubercular peritonitis. All these had been treated non-surgically. In Table IX are noted the operations performed previous to admission upon the patients in both series.

Most operators doing vaginal hysterectomies restrict their work to those patients free from adhesions and to those never previously operated upon. Generally speaking this may be wise, yet it is the experience of this clinic that even some of these (patients previously operated upon and those with adhesions), may be successfully operated upon vaginally. Occasionally, patients are seen whose general condition may be poor and their pelvic inflammation so severe that they cannot be influenced by conservative treatment. For these pelvic invalids the vaginal route is especially advantageous because following the vaginal hysterectomy there will be an absorption of exudates and a relief from symptoms, a most gratifying response to an operation one might reluctantly perform per laparotomy. One real contraindication to a vaginal hysterectomy based upon adhesions is

the presence of a tumor large enough to reach the umbilicus so that the adhesions cannot be brought down to the vagina to be separated under direct vision. Only such severe cases, treated ineffectively for long

TABLE VI
HOSPITAL DAYS

Average No. of Days	Vaginal Hysterectomy	Abdominal Hysterectomy
Total hospital days	19.5	25.4
Preoperative days	2.6	5.6
Postoperative days	16.9	19.8
Days before ambulatory	10.5	11.1

periods, are eventually operated upon per laparotomy.

The complaints (Table X) are similar to those of any larger series of hysterectomies and differ little from each other except that in the vaginal series the incidence of abnormal bleeding was greater and in the abdominal series the incidence of abdominal pain was greater. In a similar table prepared by Dupertius and Zollinger 72 per cent of the abdominal panhysterectomies complained of abnormal bleeding as compared to 25 per cent for the vaginal series. Just why this difference should exist is not known. Although a complete prolapse, especially in older patients, is in many clinics a good indication for a vaginal hysterectomy, only six in this series (none in the abdominal) had a complete prolapse. Evidently, fewer patients presented themselves with this complaint or other operative measures were instituted to control or relieve uterine prolapse.

Table XI reveals that 68 per cent of the vaginal series had a hysterectomy only, while in 70 per cent of the abdominal series both adnexa were removed. That the abdominal series had more pathology and required more extensive surgery does not entirely explain this difference. Today few men when performing a hysterectomy upon a woman near or at the menopause hesitate to remove both ovaries even though they

appear normal and healthy. However, because their removal, when operating from

TABLE VII
POSTOPERATIVE COMPLICATIONS

	Vaginal Hysterectomy	Abdominal Hysterectomy
Thrombophlebitis	5	6
Pulmonary embolism +	1	0
Bronchitis	1	1
Cystitis	10	12
Infection of abdominal wound	0	8
Rectovaginal fistula	0	1
Pleurisy	0	1
Septicemia +	0	1
Purulent peritonitis +	0	1
Pneumonia	0	2

Note: + = death.

below, is not always technically easy and may prolong operating time, it is customary to leave them intact unless they are diseased. On the other hand, when operating from above their removal is so easy that they are usually sacrificed with the uterus.

In the vaginal series anterior colporrhaphy and colpoperineorrhaphy were done when indicated. To facilitate the operation the lateral vaginal wall was incised in five patients who had shrunken vaginas, morcellement in eighteen, enucleation in one, sagittal section of the uterus in eight and incision of the uterus and cervix in two. Because it was not customary to do a routine appendectomy with every laparotomy only two appendices were removed. There were three postoperative and two umbilical herniotomies incidental to the abdominal panhysterectomy.

In the vaginal series (Table XII) the right ureter was injured in one patient. This patient ran a perfectly normal postoperative course until the seventh day when moisture identified as urine escaped from the vagina. When this persisted, three weeks later a cystoscopic examination showed that no urine appeared from the right ureteral orifice. Two weeks later 'six weeks postoperative', when spontaneous healing of the ureteral fistula could no

longer be hoped for, an exploratory laparotomy was undertaken. The ureter was exposed to the point of entrance into the bladder without demonstrating evidence of trauma. When division of the ureter at its insertion into the bladder showed urine coming from it, it was decided to implant it into the bladder. That this was successful

TABLE VIII
SYSTEMIC COMPLICATIONS

	Vaginal Hysterectomy	Abdominal Hysterectomy
Secondary anemia	2	1
Cardiac decompensation	1	1
Diabetis mellitus	1	2
Pulmonary tuberculosis	1	0

was demonstrated by the escape of urine from the new ureteral orifice during a cytoscopic examination made two weeks later. In the vaginal series the bladder during its separation from the cervix was slightly injured in one instance but not enough to require repair.

In the abdominal series the bladder was so slightly injured once as not to require repair and three times sufficiently injured to require repair. The rectum was injured in one and the sigmoid in another patient. All these injuries occurred during difficult dissections through dense adhesions and infiltrated areas. All were successfully repaired.

Immediate hemorrhage, that is surface bleeding and oozing at the conclusion of the operation from large wounds or areas denuded of peritoneum whose effective surgical control was either impossible or too time consuming, was controlled with a Logothetopulos tampon. This occurred four times in the vaginal series, seven in the abdominal. Delayed active bleeding eighth day suddenly developed from the right parametrium in one of the vaginal hysterectomies which was readily controlled with simple tamponage.

There was no morbidity in 59 per cent of the vaginal series while 41 per cent required

an average of 5.8 days to become afebrile (30 Celsus). In the abdominal series there was no morbidity in 68 per cent while 32 per cent required 5.9 days to become afebrile. There is, therefore, little difference

TABLE IX
PREVIOUS OPERATION

Vaginal Series		Abdominal Series	
Vag. diagnostic curettage	11	Lap. appendectomy	4
Vag. induced abortion	6	Lap enucleation of fibroid	1
Vag. vaginal tumor?,	2	Lap. stomach	1
Vag. removal of cervical polyp	3	Lap. sterilization	1
		Lap. Doleris-Gilliam	1
Vag. biopsy of cervix	1	Lap. drainage of abscess	1
Removal of renal calculi	1	Lap. cesarean	1
Vag. anterior colporrhaphy	1	Lap ectopic pregnancy	1
Vag. colpoperineorrhaphy	1	Lap. ovarian cyst	1
Vag. interposition	1	Vag. induced abortions	1
Vag. vesicofixation	2	Lap. adnexal tumor	5
Lap. adnexal tumor	2	Lap. cholecystectomy	1
Lap. cholecystectomy	1	Vag. diagnostic curettage	1

in the temperature reaction between the two series.

An indwelling catheter was employed in nine patients of the vaginal series and in eleven of the abdominal series. Irradiation therapy was given routinely to those in whom a diagnosis of malignancy of either uterus, cervix or ovaries was established. Therefore, eight in the vaginal series and fourteen in the abdominal series were so treated. Two patients in the vaginal series had received x-ray therapy preoperatively in a vain attempt to control functional bleeding of the menopause.

To list all the pathological findings from 200 hysterectomies would be impractical. Therefore, in Table XIII, were enumerated only the chief pathological findings and especially those that appeared to provoke the signs and symptoms indicating a hysterectomy. In common with all other surveys of hysterectomies fibroids occurred most frequently; next, internal adenomyosis for the vaginal series and diseases of the adnexa for the abdominal series. The high incidence of internal adenomyosis is striking especially when it is so rarely listed or even mentioned in similar studies made in the States; yet this diagnosis cannot be questioned, for it was in each instance made by an able pathologist, Dr. Priesel fo the Rudolfspital. This finding, however, helps to account for the high incidence of abnormal bleeding complained of by those

in the vaginal series. The ectopic pregnancy was an accidental finding during the abdominal hysterectomy. The carcinoma of

TABLE X
SYMPTOMS

Vaginal Series		Abdominal Series	
Abnormal bleeding	87	Abnormal bleeding	52
Back pain	21	Back pain	20
Abdominal pain	30	Abdominal pain	57
Urinary disturbances	3	Urinary disturbances	6
Leucorrhea	8	Leucorrhea	15
Loss of weight	6	Loss of weight	7
No symptoms	1	No symptoms	3
		Pruritus vulvae	1
		Sensation of foreign body in vagina	1
		Nausea	6

the cervix in the abdominal series was not diagnozed preoperatively, otherwise either a Wertheim or Schauta operation would have been performed. The carcinoma of the vaginal series was not diagnosed preoperatively, for the vaginal route is not know-

TABLE XI
OPERATIONS PERFORMED

	Vaginal Series	Abdominal Series
Hysterectomy	68	9
H. + bilateral adnexa	20	70
H. + right adnexa	5	7
H. + left adnexa	1	9
H. + right oöphorectomy	1	1
H. + left oöphorectomy	1	1
H. + bilateral salpingectomy	1	1
H. + left adnexa + right salpingectomy	1	1
H. + right adnexa + left salpingectomy	2	0
H. + bilateral oöphorectomy	0	1

ingly employed for malignancy of the adnexa.

Follow-up examinations (Table XIV) were made postoperatively at from two to twenty-four months. In the vaginal series eighty-three were asymptomatic at once while eleven required further treatment such as cauterization of granulation tissue or erosion of scar, diathermy treatments, sitz-baths and hot air baths before they became symptom free. Five patients due to anemia, persistent bladder symptoms, sensation of pain in the lower abdomen or to

a sensitive vaginal scar were classified as improved only. In the abdominal series eighty-seven were asymptomatic at once, seven required sitz-baths, diathermy treatments and injection of folliculin before they became symptom free. One patient had a postoperative hernia and three failed to report as instructed.

TABLE XII
OPERATIVE COMPLICATIONS

	Vaginal Series	Abdominal Series
Injury to ureter...............	1	0
Injury to bladder..............	1	4
Injury to sigmoid..............	0	1
Injury to rectum...............	0	1
Immediate hemorrhage..........	4	7
Delayed hemorrhage............	1	0

Pulmonary embolism accounted for one death in the vaginal series. This patient ran a perfectly normal postoperative course until the nineth day when without warning she suddenly collapsed and expired within four hours. In the abdominal series there were two deaths. One, on the fifth postoperative day following a panhysterectomy for a large fibroid, started with lobar pneumonia, developed otitis media, acute nephritis and sepsis and expired on the fourteenth postoperative day. The other was an exceedingly poor surgical risk that had been treated conservatively for six weeks preoperatively for pelvic inflammatory disease. Following the difficult removal of the uterus and pus tubes through a mass of adhesions her condition became critical almost at once and, despite supportive treatment, she expired on the seventh postoperative day with a diagnosis of diffuse purulent peritonitis. (All three diagnoses were verified at autopsy.) The first two can really be classified as unpreventable accidental deaths. The third patient was operated upon only as a last resort after nonsurgical treatment had proved ineffective.

A comparison of this mortality rate with that presented by several others is listed in Table xv. The low mortality rate reported for this clinic may be explained in two ways, (1) other authors have compiled their statistics from the records of several operators with varied technics while this one has been compiled from the records of but one operator; (2) others occasionally perform a panhysterectomy for carcinoma of the cervix or include Wertheims in their

TABLE XIII
PATHOLOGICAL FINDINGS

Vaginal Series		Abdominal Series	
Fibroids.............	43	Fibroids.............	41
Internal endometriosis	38	Internal endometriosis	14
External endometriosis	2	External endometriosis	4
Salpingitis...........	14	Salpingitis...........	29
Cystic ovary.........	7	Cystic ovary.........	22
Carcinoma of ovary..	1	Carcinoma of ovary..	6
Chronic cervicitis.....	5	Chronic cervicitis.....	1
Hyperplasia..........	15	Hyperplasia..........	6
Carcinoma of fundus..	5	Carcinoma of fundus..	4
Hydatidiform mole....	1	Sarcoma of fundus....	3
Uterine polyp........	1	Oöphoritis...........	8
Adenoma destruens...	1	Carcinoma of cervix...	1
Chronic metritis......	1	Ectopic pregnancy....	1
		Teratoma............	1
		Brenner's tumor of ovary.............	1

statistics, while in this clinic the Wertheim is performed only for carcinoma of the cervix and these were not included in the survey.

COMMENT

It is hoped that this analysis of vaginal hysterectomies (gathered over a period of two years), and of abdominal panhysterectomies (gathered over a period of four years), none of which have been previously reported will prove to be an acceptable contribution to the literature. That the vaginal route for panhysterectomy should be employed whenever possible has long been maintained by such men as Babcock, Tyrone, Heaney, Kennedy and many others. Chavannaz of France, modern pioneer of vaginal hysterectomy, performs only about 5 per cent of all his panhysterectomies per vaginam while Werner performs about 66 per cent of all his panhysterectomies by that route.

While carcinoma of the cervix or the adnexa, the presence of dense adhesions and a tumor extending up to the umbilicus

and chronic appendicitis remain real contraindications to employing the vaginal route, the marked advantages of this route cannot lightly be ignored. A better appreciation of the shorter operating time, shorter hospitalization, lower mortality and morbidity rates, smoother convales-

TABLE XIV
FOLLOW-UP STUDIES

	Vaginal Series	Abdominal Series
Asymptomatic at once	83	87
Asymptomatic finally	11	7
Improved only	5	1
Failed to report	0	3

cence, fewer operative and postoperative complications and excellent end results achieved would we believe, if generally appreciated, eventually persuade surgeons

TABLE XV
MORTALITY RATE

	Vaginal Series	Abdominal Series
Witherspoon and Butler	2 7	5 3
Faulkner	2 9	2 6
Dupertius and Zollinger	0 0	4 0
Werner	1 0	2 0

to elect the vaginal route in preference to the abdominal wherever possible.

TECHNIC

The essential features of a simple vaginal hysterectomy according to Dr. Werner's technic are as follows: circumcision of the cervix at the junction between the smooth part of the mucous membrane immovably adherent to the cervix underneath and the wrinkled movable part; advancing the bladder off the cervix and opening the anterior cul-de-sac: opening the posterior cul-de-sac; tying off the parametria; rolling the fundus forward into the vagina; separation of the uterus from the adnexa; fixation of the peritoneum and the stumps of the adnexa and parametria to the edge of the

vaginal mucosa; and tying together of these last placed lateral sutures, thus closing the cavity. When the adnexa are removed, this last step is unnecessary for a prolapse of the bowel never occurs.

The abdominal panhysterectomy differs but little from the technics commonly employed, although emphasis is placed upon the exact control of hemorrhage by dissecting free all ligaments before opening the vagina and the placing of clamps to both sides of the vagina with adjacent connective tissue. Failure to place these clamps invites oozing from one or both sides of the vaginal walls which can be controlled with difficulty only by placing many ligatures in a field rendered dangerous by the close proximity of the ureter.

The Logothetopulos tampon differs from the Mikulicz's tampon in that ends of it projecting from the vulva are twisted and under tension fixed to a pessary ring in front of the vulva. This tension is maintained for about six hours. Both the Logothetopulos and the Mikulicz's tampons are removed gradually, a portion of it being withdrawn day by day until it is finally removed upon the sixth or seventh days. While the tampon is in situ, it is wise to place an indwelling catheter because these patients are rarely able to void spontaneously.

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MECKEL'S DIVERTICULUM*

REPORT OF TWO CASES

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ELKINS, WEST VIRGINIA

ONCE considered an anatomical curiosity, Meckel's diverticulum is now recognized as a definite pathological entity, as the result of numerous case reports and related publications appearing in recent years.

HISTORY

Lavater,[1] in 1671, reported his observations on an instance of diverticulum of the terminal ileum. This is one of the first recorded cases. In 1707, Ruysch[2] gave an excellent illustration of such a diverticulum in his Thesaurus Anatomicus. Morgagni,[3] in 1769, discussed diverticula of the intestine. He did not believe, however, that diverticula of the ileum had any relation to the omphalomesenteric duct.

It was Johann Friedrich Meckel (1781–1833) to whom the credit is given for the first association of the diverticulum of the terminal ileum with the omphalomesenteric duct. Livingston[4] has pointed out that considerable confusion has arisen regarding the credit because of the fact that two anatomists, grandfather and grandson, had identical names. Credit is given by many writers to the elder Meckel (1717–1774). However, the writings of this anatomist fail to show that he studied or described the diverticulum in question. The elder Meckel described the sphenopalatine ganglion and the space enclosing the Gasserian ganglion (Meckel's ganglion and Meckel's Cavity), but it was the grandson who studied and wrote extensively concerning the omphalomesenteric duct and described the diverticulum occasionally found as a remnant of this fetal structure. In 1809, he compiled a collection of all cases recorded to that date. He also pointed out the association of the diverticulum with other congenital anomalies, such as hare lip, cleft palate and bicornate uterus.

EMBRYOLOGY

Ordinarily the proximal end of the yolk stalk becomes obliterated early in fetal life, usually beginning about the fifth week. When it remains as a sac or pouch of varying lengths and attachments, it is known as Meckel's diverticulum. The yolk sac at first is filled with the vitelline fluid, which probably is utilized for nourishment of the embryo in the early stages of its existence. It later has an important function in the formation of blood, the first blood cells and vessels developing in the outer mesodermal layer. At the end of the fourth week the yolk sac appears as a pear-shaped vesicle (the umbilical vesicle), opening into the intestine by a long narrow tube, the omphalomesenteric (vitelline) duct. As stated above, obliteration starts at about the fifth week of fetal life and is completed at about the seventh week. In rare cases there may be no closure, and a fistulous opening from the intestine through the umbilicus results. In some instances there is an obliteration except for the distal portion and as a consequence there is an umbilical fistula with secretion from the still active glandular elements in the mucosa. In other rare instances, the proximal and distal portions close but an opening may remain in the middle portion. Due to secretory activity a retention cyst is formed, the so-called enterocystoma. The usual type, however, is a diverticulum of varying size and length originating from

the terminal ileum, the distal end either lying free in the peritoneal cavity or connected by a fibrous band to the umbilical
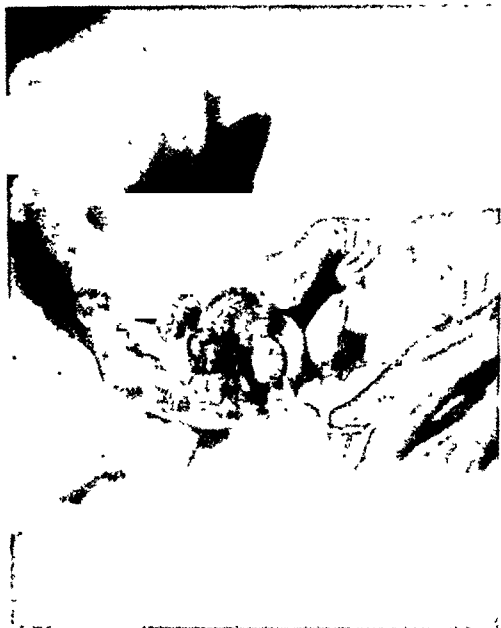

FIG. 1. Case 1. The diverticulum as seen at operation.

region. Very rarely, there may even be a duplication of the diverticulum. Carlson[5] recently reported a case in which there were two diverticula about 20 cm. apart in the ileum. The anomaly was found in a thirty-eight week old male fetus. Elements of the gastrointestinal tract other than mucosa of the small intestine are found at times in the diverticulum. Such elements may include gastric and duodenal mucosa, and aberrant pancreatic tissue. Greenblatt[6] and his co-authors estimate that 15 to 25 per cent of the diverticula show the presence of heterotopic tissue.

INCIDENCE

The diverticulum is found in about 2 per cent of autopsies. In 2,050 postmortem examinations at the New York Hospital, the diverticulum was present in thirteen cases. Christie[1] recently presented a pathologic study of sixty-three cases found in 5,768 autopsies at Babies Hospital, an incidence of 1.1 per cent. Gray's Anatomy[7] gives an incidence of 2 per cent; Richardson,[8] 1.5 per cent.

SEX DISTRIBUTION

The proportion of males to females is estimated as 3:1. Ketteler[9] in reporting 109 cases of Meckel's diverticulum found only eighteen cases in females as compared with ninety-one in males. No satisfactory explanation has ever been offered for this difference in the sex incidence.

LOCATION AND SIZE

The usual location of the diverticulum is approximately 100 cm. from the ileocecal valve and opposite the mesenteric attachment of the gut. It may be found anywhere in the gastrointestinal tract from the cardia to the rectum in rare cases, according to the statement of Nygaard and Walters.[10] Hadley and Cogswell[11] recently reported a diverticulum which had its origin from the base of the appendix. In a search of the literature prior to their report, they were unable to find any reference to a diverticulum nearer than 4 cm. to the ileocecal valve. Cunningham's Anatomy[12] states that, in a large series of autopsies, the greatest distance from the valve was 12 feet and the least was 6 inches. In a series of sixty-three cases reported by Christie the diverticulum nearest to the ileocecal valve was 15 cm. and the most distant was 90 cm. The usual location is opposite the mesenteric attachment but this may not always be the case. Thompson[13] reported a case of perforated peptic ulcer in a Meckel's diverticulum, the diverticulum being intramesenteric in position. There may or may not be a separate mesentery. In size it may vary from a barely perceptible outpouching of the intestinal wall to the huge diverticulum reported by Moll[14] which measured 33½ inches (85.09 cm.) in length. Goldstein and Cragg[15] recently reported a diverticulum measuring 66 cm. in length which was removed from a five year old girl at operation. An unusual feature of this diverticulum was that it shared a single mesentery with the ileum. Occasionally the diverticulum may be bifurcated. Hyrtl[16] presented a patient in which it was not only bifurcated

but serrated into five distinct parts. The average diverticulum is, however, approximately the size and length of a finger.
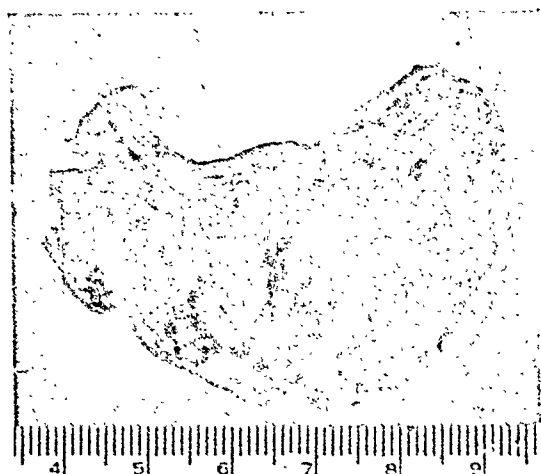

FIG. 2. Case 1. Cross section of the fixed specimen showing the almost complete obstruction of the lumen by triangular cone.

COMPLICATIONS

The majority of persons having this anomaly undoubtedly go through life entirely symptom-free. It has been estimated that approximately one-fourth of all cases will eventually show some pathologic change.

a. *Hemorrhage.* Gastric mucosa frequently is found in the diverticulum. Farr and Penke[17] found such mucosa in six of thirteen diverticula while Hudson and Koplik[18] also found about the same proportion, twelve cases out of a total of twenty-three showing gastric mucosa. Ulceration with hemorrhage is probably the most common complication. In thirty-two cases reported by Hudson and Koplik,[18] seventeen showed hemorrhage either with or without other signs. Bleeding from the rectum is therefore an extremely important diagnostic sign, especially in the acute surgical diseases of the abdomen.

b. *Perforation.* Perforation into the peritoneal cavity is the next most common complication. The first authentic report of a definite peptic ulcer within a Meckel's diverticulum was made in 1913 by Hubschmann.[19] He operated on a four and a half year old boy for an "acute abdomen" and

found a perforated peptic ulcer in this organ. Examination of the specimen showed a typical perforated peptic ulcer with

FIG. 3. Case 11. X-ray picture showing the isolated collection of barium in the region of the umbilicus.

gastric mucosa lining nearly all of the diverticulum.

c. *Diverticulitis.* The diverticulum may also be the site of a purely inflammatory process, the so-called diverticulitis. The inflammation may be acute catarrhal in character or the more serious suppurative and gangrenous forms with accompanying abscess formation and peritonitis. The symptoms of an acute diverticulitis differ in no way from a similar inflammatory change in the appendix. A differential diagnosis is usually impossible. The treatment, fortunately, is the same in both instances, i.e., surgical intervention.

d. *Obstruction.* Intestinal obstruction is another complication of a Meckel's diverticulum. In a diverticulum extending to and adherent in the umbilical region, a loop of bowel may drop across the diverticulum causing obstruction as in Case 1 below. In inflammation of the diverticulum the inflamed portion may become adherent

to adjacent intestine, producing obstruction by compression and constriction. Intussusception not infrequently occurs if

FIG. 4. Case II. Microphotograph showing the glandular structure of the diverticulum similar to that of the gastric fundus.

the diverticulum should become invaginated, in which case it acts as a polyp within the lumen of the bowel. Volvulus is an occasional finding.

e. New Growths. Rarely the diverticulum may be the site of new growths, either benign or malignant. Nygaard and Walters in a survey made in 1937 found a total of twenty cases of malignant tumors of Meckel's diverticulum. Fourteen cases were of sarcoma and six of carcinoma. Of benign tumors, myoma and lipoma of the diverticulum have been reported.

f. Miscellaneous. Very rarely, the diverticulum may be the site of a tuberculous or typhoid ulceration. In the latter, the ulceration requires the presence of Peyers' patches.

CASE I. This was an obstruction of the bowel associated with torsion and gangrene of a Meckel's diverticulum. A young male, aged 25 years, American born, a coal loader, had been in good health up to the onset of the illness, except for a mild constipation. About 4 A.M. on May 18, 1938, he was awakened by severe intermittent cramping pain, localized in the region of the umbilicus. At about the same time he felt a desire to defecate and, as he could not walk due to the pain, he dragged himself to the toilet where he had a very loose stool. This relieved the pain and he was comfortable for one hour. Following this, the cramping pain again returned, fully as severe as before, caus-

ing him to writhe in bed. He was nauseated and vomited once about 6 A.M., the vomitus being watery and green in color. The nausea persisted but there was no further vomiting. His family physician first saw the patient about 9 A.M. By this time the pain had changed from a severe intermittent cramping to a continuous dull ache localized just below the umbilicus. Hospitalization was advised but the patient refused until four hours later when the persisting pain finally caused him to make the trip. He was admitted to the hospital at 2 P.M. approximately ten hours after the onset of illness. The past history was important in that four years previously he had had an attack of severe cramping pain similar to the present illness. That attack lasted only about fifteen minutes and had been relieved by a small dose of paregoric. His only previous hospitalization had been in 1933 for the surgical correction of a ventral hernia directly above the umbilicus. He had had the usual childhood diseases. He had been in excellent health prior to the onset of the present illness; on the previous evening he had practised baseball with a local team. He had taken no cathartics prior to his illness.

Examination revealed that the patient was a well developed and well nourished, stocky, white adult male, obviously acutely ill, and complaining of continuous aching pain just below the umbilicus. The pulse rate was 96; the blood pressure 158 systolic and 104 diastolic; the temperature 100°F. by mouth. His respirations were 20 per minute and predominately thoracic in type. Examination of the mouth and throat showed an extremely high, hard palate but there was no evidence of congenital stigmata otherwise. The teeth showed numerous extractions and moderate caries. The heart and lungs were entirely normal to physical examination. Inspection of the abdomen showed a healed surgical scar 2½ inches in length, directly above the umbilicus. There was moderate distention, especially in the upper abdomen. There was tenderness to palpation over the lower abdomen, a little more marked on the right side than on the left. On deep palpation a mass could be made out lying about 1 inch below and to the right of the umbilicus. The mass was deeply situated, its size and position could not be definitely determined. Rebound tenderness was marked. The abdominal wall moved only slightly with respiration. No peristaltic waves were noted. A fluid wave,

areas of shifting dullness and obliteration of liver dullness were absent. The rectum was empty and no mass could be felt in the lumen above or impinging on the rectal wall. There was tenderness to pressure high up and on both sides of the rectum. The erythrocyte count was 4,000,000, and the leucocyte count 16,000 with 95 per cent polymorphonuclears. Urinalysis was unchanged.

Because of the severity of the abdominal symptoms, coupled with the palpable mass, fever, and leucocytosis, immediate operation was advised. A preoperative diagnosis was made of intestinal obstruction, cause unknown.

Under spinal anesthesia (neocaine, 150 mg. introduced into the third lumbar interspace) with ether analgesia in the latter stage, the peritoneal cavity was entered through a right rectus incision. A moderate amount of cloudy, odorless, brownish fluid was encountered and was removed by aspiration from the peritoneal cavity. The intestines were moderately distended and showed slight hyperemia. Lying in the lower portion of the right hypochondrium, just anterior to the gallbladder, was a dark, gangrenous object, about the size of an ordinary sausage. At the proximal end, the mass was found to communicate with the small intestine along the antimesenteric border and apparently in the region of the terminal ileum. The distal end was traced to the umbilicus, establishing the diagnosis of a strangulated Meckel's diverticulum. The diverticulum showed marked torsion, being twisted on itself through two complete turns at the intestinal and umbilical junctions. Lying across the strangulated diverticulum, in a manner similar to which clothes may be hung on a line, was found a loop of small intestine, measuring about 15 inches. This was kinked sharply at the point of crossing the diverticulum causing an obstruction of the small bowel. This loop of bowel was more distended than the remainder of the intestine and of a darker color due to circulatory stasis. The obstructed loop of gut was pulled up and returned to its normal location within the peritoneal cavity with a marked improvement in the color of the loop after this procedure. The abdominal cavity was then protected by gauze against soiling and the diverticulum brought up into the operative field. The base of the diverticulum was clamped, cut, carbolized and invaginated into the ileum using a black silk purse string suture. A few reinforcing sero-

muscular sutures were then placed at the site of the inversion. The caliber of the adjacent intestine was not appreciably diminished by this procedure. The distal, fibrous end of the diverticulum above the site of torsion was then clamped and cut, and a chromic No. 1 tie placed about the remaining short stump. The appendix was grossly normal and was removed in the usual manner prior to closure.

The patient had a smooth and uneventful recovery following the operative procedure. The highest elevation of temperature, 100.6°F. occurred thirty-six hours after operation. This became normal the following morning and remained so for the duration of the hospital stay. There was no nausea or vomiting and only a slight distension for forty-eight hours after operation. The sutures were removed on the eighth postoperative day. The wound remained clean and healed by primary intention. The patient was allowed out of bed on the tenth and was discharged on the fourteenth postoperative day. Since leaving the hospital the patient has been seen from time to time in the out-patient department, the last visit being almost a year after operation. There have been no complaints referable to the gastrointestinal tract. Recent examination showed him to be in excellent physical condition. The abdomen was soft, the scar firm and there were no areas of tenderness. The patient has resumed his regular occupation and activities; he is now playing semiprofessional base ball several times a week.

The pathologic report stated that the diverticulum measured 5.4 by 4.0 by 2.2 cm. (after fixation) and bore a striking resemblance in form to a stomach. Both the proximal and distal ends were about 0.5 cm. in diameter and showed several complete twists. The color was purplish black with little patches of fat being seen in the external wall. A longitudinal section was made connecting the edges of the lesser and greater curvatures. A valve-like triangular cone was found originating from the lesser curvature near the intestinal end. This cone projected into and partially obstructed the lumen of the diverticulum. Microscopic examination revealed the diverticulum to be so thoroughly necrotized as to make impossible any recognition and defination of glandular structures. The whole tissue was impregnated with blood. Large areas showed the segmented nuclei of polymorphonuclear leucocytes, and in

other regions pycnotic nuclei surrounded by undefinable cell débris were seen. Pancreatic tissue was not found.

CASE II. This was an instance of bleeding Meckel's diverticulum in an eleven months old infant. A white, male infant, aged eleven months, was admitted to the hospital on July 5, 1939, because of bleeding from the bowels. The patient was a full term baby, spontaneous delivery. His first tooth erupted at six months, he was able to sit up at nine months, and the weight curve had been satisfactory since birth. There was no history of any illness since birth other than a mild, acute upper respiratory infection when six months of age, which cleared completely after about seventy-two hours. The onset of the present illness dated to three months prior to admission when the mother noticed a blood stained diaper. Thirteen days after the initial attack, the baby passed a large amount of blood from the bowels, enough to fill several diapers with clots. The baby appeared very pale and was taken to a hospital where a transfusion was given. For five days following this the stools were dark and blood stained. No cause or source of the bleeding was found at that time. The baby picked up very well and there was no further difficulty until just prior to admission when the mother noticed that the diapers were again blood stained with several large clots also present. The baby was then brought immediately to the hospital for further care.

When first seen at the hospital, the patient was a very well developed and well nourished, stocky, white male infant, lying quietly in bed, not appearing acutely ill. Examination of the head showed the anterior fontanelle to be widely open. The eyes, ears, nose and throat were normal except for a very high, hard palate. Six teeth had erupted. The heart and lungs were entirely normal. Examination of the abdomen revealed no abnormalities. The wall was soft and no masses were palpable. A few small lymph nodes were palpable in each inguinal region. The red cell count on admission was 4,100,000 and the white cell count 10,500 with 83 per cent hemoglobin.

The baby was placed under observation in the hospital and treated with small doses of paregoric and phenobarbital for sedation. On the day following admission, a gastrointestinal study was carried out. The opaque meal was followed through the small intestine and colon.

Films taken in the lateral position showed a few flecks of barium near the umbilicus which might have indicated the position of a Meckel's diverticulum. At the end of six hours, however, an isolated collection of barium was found in the region of the umbilicus, the balance of the meal lying in the lower portion of the intestine, to the right of the midline. The roentgenologist noted that the margins of the isolated accumulation were less regular than the remainder of the intestine. He stated that this could very well be a Meckel's diverticulum filled with barium. The stools during this period of observation were dark in color but no gross blood was noted. The benzidine reaction, however, was 4 plus. Four days after admission, the baby again had two grossly bloody stools with several large clots, and on the following day there were three grossly bloody bowel movements. The red cell count showed a drop to 2,600,000 cells and the hemoglobin had been reduced to 50 per cent. The baby seemed to be more listless and pallor was increasing from day to day. It was believed that an exploratory laparotomy could no longer be delayed in view of the continued passage of blood and the rapid drop in the red blood cell count. A pre-operative diagnosis of a bleeding Meckel's diverticulum was made and the patient prepared for surgery.

Under drop ether anesthesia, the peritoneal cavity was entered through a right rectus incision. The bowel loops were distended and tended to bulge up into the field. The cecum was identified and found to be filled with dark appearing material within the lumen. The appearance suggested the possibility of blood in the bowel. The ileum was then followed back, and approximately 18 inches from the ileocecal valve, a Meckel's diverticulum was found. The diverticulum had the appearance of a rimless derby hat lying on top of the bowel. It showed a very wide base and measured about ¾ inch in height. There was a moderate thickening to palpation when compared to the adjacent intestine, and several large vessels could be traced up from the bowel into the diverticulum. There was no mesentery. The diverticulum was brought up into the field and the adjacent intestine packed off to prevent soiling. A Dawson-Furniss crushing clamp was applied across the base and the diverticulum removed by cutting. The edges were carbolized and the clamp removed. Several bleeding vessels were

picked up and tied off with fine silk. Using the Connel stitch, the crushed edges were then inverted into the lumen with black silk. Three black silk supporting mattress sutures were then placed for reinforcement. At the close of the procedure, there was only a slight diminution in the caliber of the intestine, and on manipulation, gas could easily be passed through the slight constriction. The lumen appeared to be of sufficient size to permit the passage of an ordinary lead pencil. The appendix was grossly normal and was removed in the usual manner prior to closure. The abdominal cavity was not drained.

A transfusion of 175 cc. of blood into the brachial vein was given immediately after the operative procedure. The course during the first forty-eight hours following operation was very satisfactory. The feedings were well taken and there was very little abdominal distention. A formed stool which was covered with fresh blood was passed on the third postoperative day, followed several hours later by the passage of a second stool containing a large number of blood clots. Koagamin coagulant (Millar) was then administered intramuscularly in 3 cc. doses every three hours until a total of 12 cc. had been given. Two blood tinged stools were passed on the fourth postoperative day. The stools from that time on were free of gross blood, although the benzidine test remained positive for two more days. The patient was discharged on the eleventh postoperative day. The erythrocyte count was 3,100,000 and the hemoglobin 63 per cent at this time. The patient was seen recently in the out-patient department (January, 1940) and was found to be in excellent physical condition. A gastrointestinal study at this time was normal. The isolated collection of barium which had been found and identified as the diverticulum prior to operation was not seen at this time. There had been no further passage of blood in the stools.

The pathologic report was as follows: The diverticulum measured 2.5 cm. in height with a diameter of 2.75 cm. at the base. On the inner aspect, the mucosa was 1 mm. in thickness and thrown into numerous folds. The muscularis was 0.5 mm. in thickness. No ulcerations or bleeding points were seen. The microscopic examination revealed long tubular glands in the mucosa. Chief cells and many brightly stained parietal cells were seen. There were no focci of inflammation or areas of hemorrhage. A patho-

logic diagnosis was made of Meckel's diverticulum containing mucosa similar to that of the gastric fundus.

SUMMARY

1. A brief review is given of the history, embryology and incidence of Meckel's diverticulum.

2. The complications which may result from the presence of such a diverticulum are noted.

3. A case of bowel obstruction associated with torsion and gangrene of a Meckel's diverticulum is presented.

4. A case of bleeding Meckel's diverticulum in an eleven months old infant is presented.

CONCLUSIONS

1. The passage of blood by rectum, especially in children and in the presence of acute abdominal disease, should arouse suspicions of a Meckel's diverticulum.

2. Examination of the terminal ileum should, when possible, be routinely undertaken in abdominal operations.

3. In any abdominal surgery in which an adequate pathologic condition to explain the clinical findings is not found, a Meckel's diverticulum should always be ruled out.

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AFTER middle life the sigmoid region of the gut becomes pouched in many places. These pouches are harmless unless they become inflamed.

COLOR ILLUSTRATIONS

COLOR illustrations, from time to time, have made their appearance in the pages of The American Journal of Surgery, and it has long been our ambition to offer more of these to our readers. Foreign scientific journals, because of lower labor costs, have been generous in publishing color illustrations. Often this has been made possible because of endowments for this purpose, as in the case of the *British Journal of Surgery*. In this country color illustrations, particularly when four colors are used, are very expensive. One such picture often runs into several hundred dollars, thus making the cost to both author and publisher prohibitive.

Pictures in color tell a great deal more than do just black and white reproductions; the position, relations, structure and functions of the human body are more clearly visualized and better understood when depicted in color. It is, therefore, with pleasure that we publish four color plate illustrations in this issue. This marks the beginning of what we anticipate will be a regular presentation at stated intervals throughout the year, as pictures of merit present themselves to your editor.

The fine illustrations in this number have been made possible by the generosity of the Petrolagar Laboratories, of Chicago, who met the expense of the artist, Dr. Frank Netter, and of the engraver in the production of the plates. Under this arrangement the Journal can give them to its readers prior to their use in other forms.

This co-operative presentation to our readers is frankly an innovation, one which should add materially to the value of the publication.

T. S. W.

LOWER BOWEL, RECTUM AND ANAL CANAL

Mucous Surface of the Pelvic Colon, Rectum and Anal
    Canal

The Veins of the Descending and Sigmoid Colons, Rectum and
    Anal Canal

The Arterial Supply of the Sigmoid Colon, Rectum and Anal
    Canal

Musculature of the Lower Bowel

Mucous Surface
of the Pelvic Colon,
Rectum and Anal Canal
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MUCOUS SURFACE OF THE PELVIC COLON, RECTUM AND ANAL CANAL

THE mucous membrane of the lower end of the bowel is a thick, vascular layer. The surface of the sigmoid colon is usually considerably more rugous than that of the rectum. On sigmoidoscopic examination a rather sharp demarcation can often be seen between these two surfaces and this transition is demonstrated in the illustration. Scattered throughout the mucous membranes are numerous solitary lymphatic nodules.

Within the rectum there are three shelf-like projections, known as the "Valves of Houston." The uppermost and lowermost of these arise from the left side and the middle one from the right side of the bowel. At the lower end of the rectum the mucosa is gathered into longitudinal folds, approximately ten in number, known as the "Rectal Columns" or "Columns of Morgagni." These columns are united at their lower extremities by transverse semilunar mucosal folds to which the term "Anal Valves" has been applied. Each anal valve thus forms one wall of a pocket or saccule which is bounded externally by the rectal wall and on each side by a rectal column. These pockets are called "Crypts of Morgagni," or "Saccules of Horner." They are quite important clinically as they form a common point of entrance for infective organisms. Shortly below this point there is a transition from the intestinal mucosa to the anal skin.

# THE VEINS OF THE DESCENDING AND SIGMOID COLONS, RECTUM AND ANAL CANAL

THE venous system of the lower rectum comprises two plexuses, the internal or superior hemorrhoidal plexus (I.H.P.), and the external or inferior hemorrhoidal plexus, (E.H.P.). The internal or superior hemorrhoidal plexus consists of a network of small veins situated in the submucosa above the anorectal line. In the illustrations, a panel of mucosa has been removed from the posterior rectal wall to show this network. On the anterior wall, the muscular layer has been cut away at a higher level than has the mucosa in order to demonstrate the manner in which the small veins of this plexus course upward. At about the middle of the rectum, the veins penetrate the muscular layer. They continue upward on the outer surface of this muscular layer, uniting with one another to form the right and left branches of the Superior Hemorrhoidal Vein (R.S.V.) (L.S.V.). These branches course upward on the posterior aspect of the rectum and unite to form the Superior Hemorrhoidal Vein proper (S.H.V.). This in turn drains by way of the Inferior Mesenteric Vein (I.M.V.) and Splenic Vein (S.V.) to the Portal Vein (P.V.) and thus to the liver.

The External or Inferior Hemorrhoidal plexus is located *outside* the muscular layer of the lower rectum and anal canal. It is drained on each side by two veins, the Middle Hemorrhoidal, (M.H.V.) and the Inferior Hemorrhoidal (I.H.V.). The Inferior Hemorrhoidal vein is a tributary of the Internal Pudendal Vein (I.P.V.) which in turn enters the respective Hypogastric Vein (H.V.). The Superior Hemorrhoidal Vein drains directly into the Hypogastric. The Hypogastric Vein on each side joins the External Iliac to form the Common Iliac Vein (C.I.V.) and the two common Iliacs unite with each other to form the Inferior Vena Cava (I.V.C.) leading to the heart.

It is thus obvious that the Internal or Superior Hemorrhoidal plexus drains by way of the "Portal Circulation" while the External or Inferior plexus drains by way of the "Caval Circulation." The two plexuses, however, anastomose with each other (An.) and this anastomosis is of considerable significance as it forms a juncture point of the two great venous systems—the caval and the portal.

The blood from the Sigmoid Colon and Descending Colon is drained by way of the Sigmoid Veins (S.V.) and the Left Colic Vein (L.C.V.) into the portal circulation.
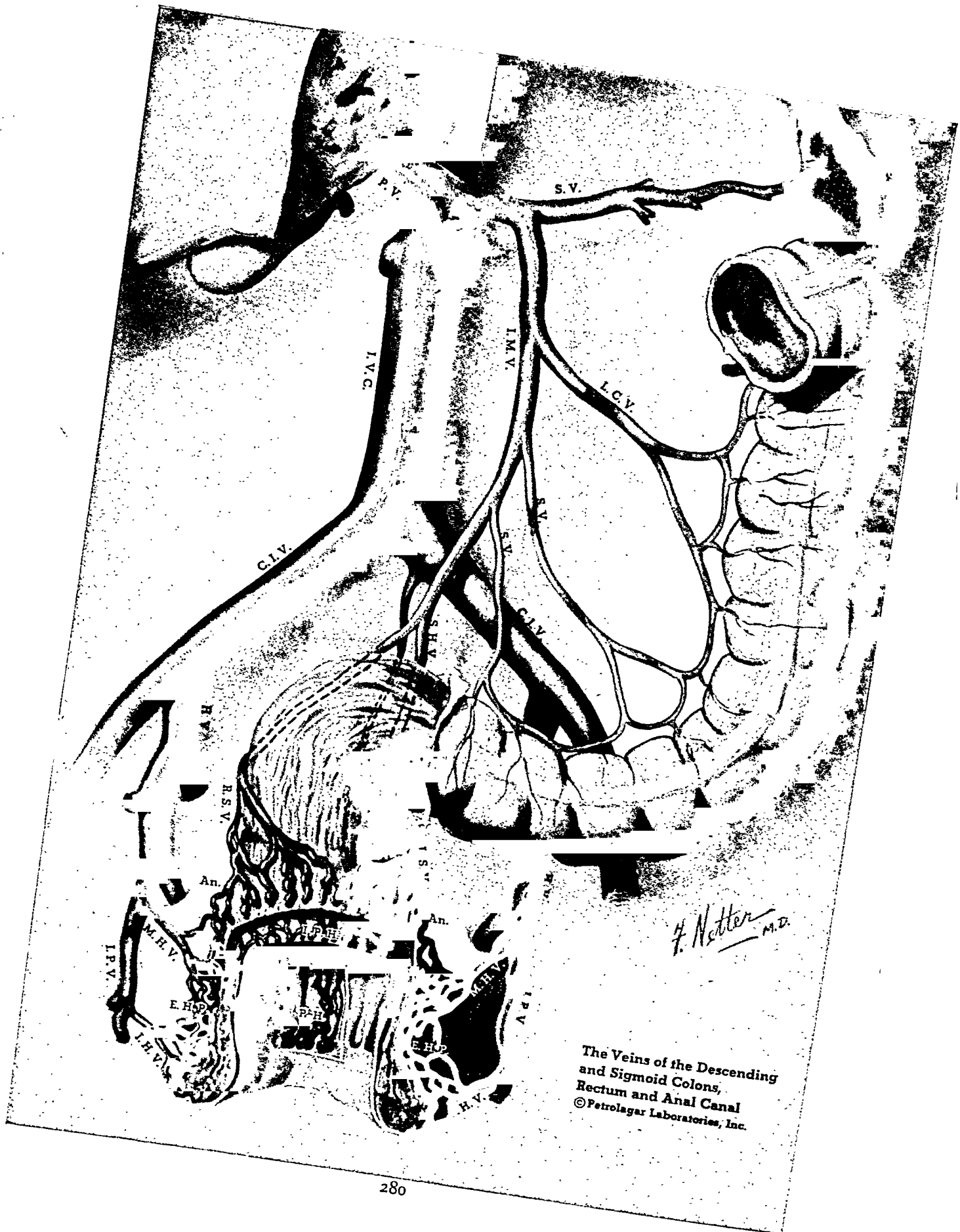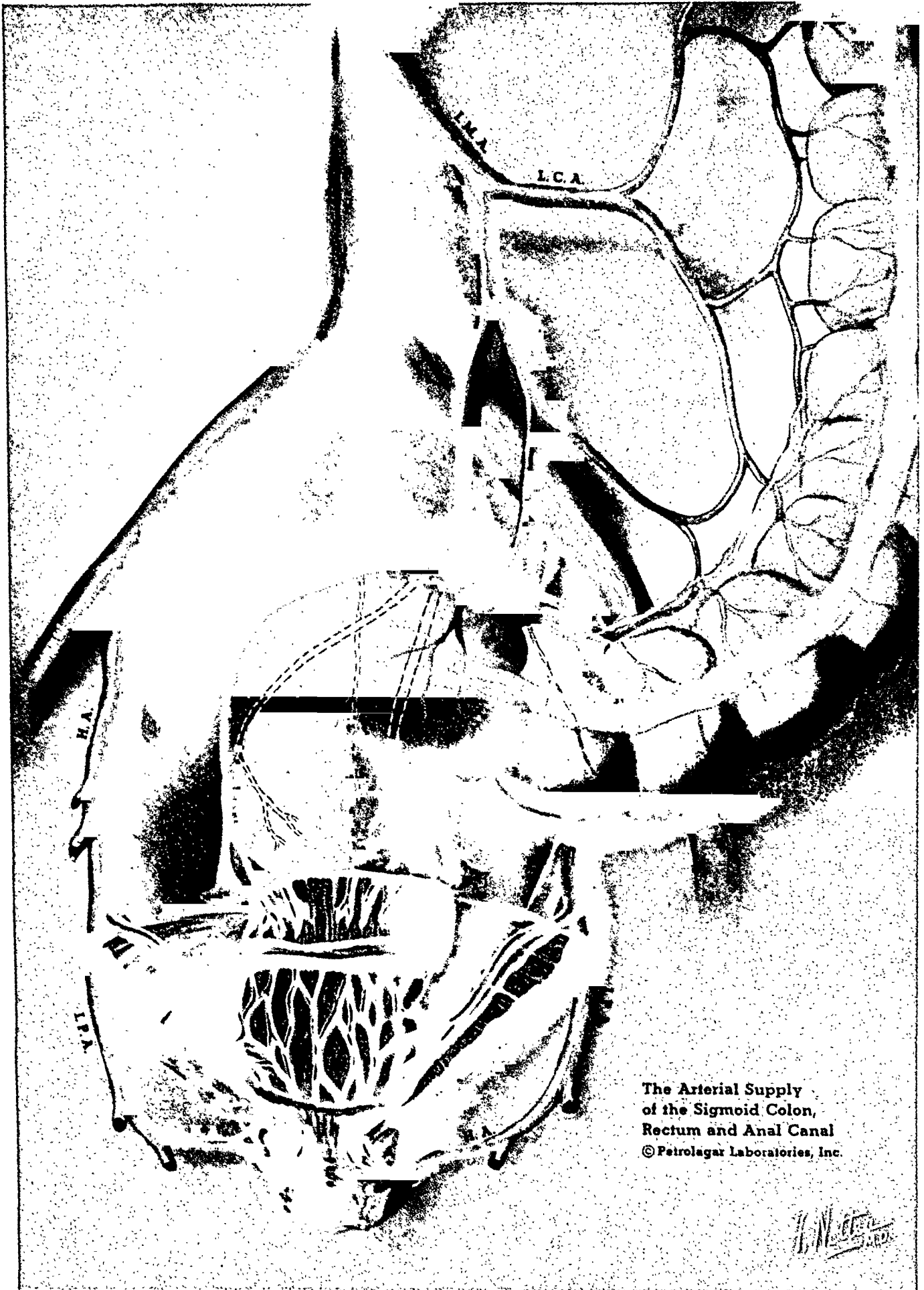
The Veins of the Descending
and Sigmoid Colons,
Rectum and Anal Canal
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The Arterial Supply
of the Sigmoid Colon,
Rectum and Anal Canal

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THE ARTERIAL SUPPLY OF THE SIGMOID COLON, RECTUM AND ANAL CANAL

THE Inferior Mesenteric Artery (I.M.A.), by means of its three branches, the Left Colic Artery (L.C.A.), the Sigmoid Artery (S.A.) and the Superior Hemorrhoidal Artery (S.H.A.), provides the blood supply for the descending colon, the sigmoid and the upper part of the rectum. The Left Colic Artery, in its rout to the colon, divides into branches which unite with each other to form a series of arcades. From these arcades branches are given off to the bowel. The uppermost branch of the artery anastomoses with the descending branch of the middle colic artery, while the lowermost anastomoses with a branch from the sigmoid artery. The Sigmoid Artery and the Superior Hemorrhoidal are the two terminal branches of the Inferior Mesenteric Artery.

The Sigmoid Artery courses downward in the Sigmoid mesentery and divides into branches which supply the Sigmoid Colon. The Superior Hemorrhoidal Artery crosses the left common iliac vessels and enters the pelvis to reach the posterior surface of the upper end of the rectum. Here it divides into a right and left branch which continue downward, winding around the rectum and subdividing further. At about the level of the peritoneal reflection, these branches pierce the muscular coats and form a plexus in the submucosa. This plexus also receives branches from the Middle and Inferior Hemorrhoidal Arteries (M.H.A.) (I.H.A.).

There are two Middle and two Inferior Hemorrhoidal Arteries (right and left). They arise from the anterior divisions of the respective Hypogastric Arteries (H.A.) and course medially over the pelvic floor to the sides of the rectum where they pierce the muscular layers and anastomose with branches from the Superior and Inferior Hemorrhoidals to form the submucous plexus. The Inferior Hemorrhoidal Artery on each side arises from the Internal Pudendal Artery (I.P.A.), a branch of the Hypogastric (H.A.), after that vessel has left the pelvis, i.e., in the Ischiorectal Fossa. It courses medially toward the anus, where it breaks up into branches that take part in formation of the submucous plexus. The Middle Sacral Artery (M.S.A.) also supplies a few branches to the posterior aspect of the rectus.
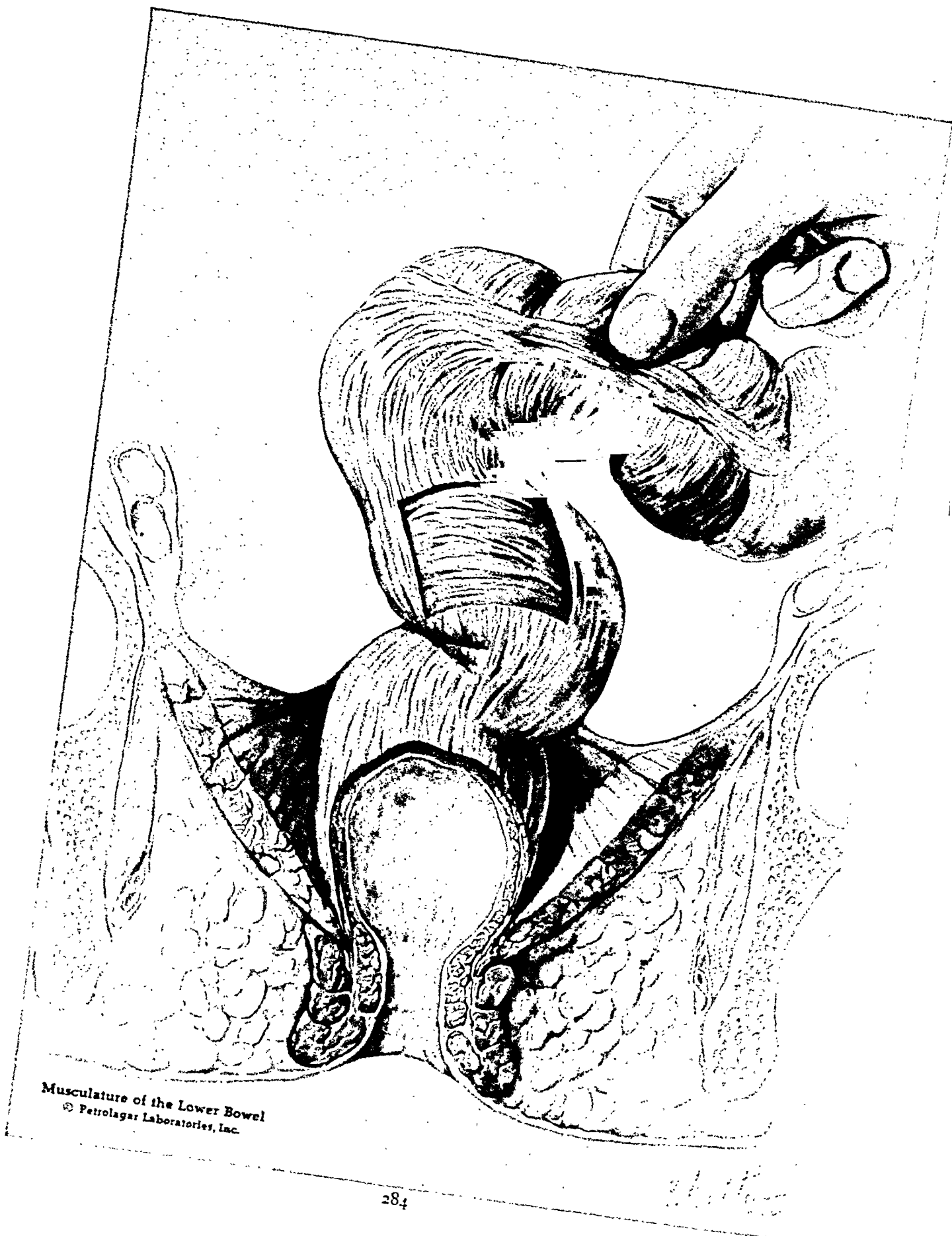
MUSCULATURE OF THE LOWER BOWEL

THE musculature of the large intestine is comprised of a circular layer and longitudinal layer. In the cecum, ascending colon, transverse colon, descending colon and sigmoid colon, the longitudinal layer is collected into three longitudinal bands—only one of these bands (the taenia libera) is visible anteriorly. At the juncture of the sigmoid colon with the rectum, the bands broaden out and fuse so as to form a complete external longitudinal layer of muscle over the rectum. This transition is illustrated here.

A rectangular window has been cut in this superficial layer of longitudinal muscle to demonstrate the underlying circular musculature. Lower down, the anterior portion of the rectal wall has been cut away in order to illustrate the formation of the sphincter and the attachment of the levator ani muscle. About 4 cm. meters above the anal margin, the circular muscle increases in thickness so as to form the internal rectal sphincter. The longitudinal muscle is continued down and is inserted partly into the levator ani and partly into the fascia around the anus.

The external sphincter is a voluntary muscle somewhat elliptical in shape, surrounding the anal canal and extending from the tip of the coccyx posteriorly to the perineum anteriorly. As illustrated, it is folded on itself at its lower extremity so as to form a superficial and deep layer of fibers. About midway of the anal canal the deep layer meets the internal sphincter. At this juncture there is a depression, not always discernible to the eye, but palpable to the finger. This line has been termed the "White Line of Hilton." On each side of the rectum the levator ani is shown forming the pelvic floor and above this the semilunar peritoneal folds which form the pararectal fossae are represented.

The levator ani, the external sphincter, the obturator muscle overlying the ischial bone form, on each side, an angular space known as the ischiorectal space. Laterally, the fossae of the hip joints are represented.

Musculature of the Lower Bowel
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OBSTRUCTION OF THE SIGMOID FLEXURE BY A LARGE GALLSTONE

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ILEUS caused by the impaction of a gall-stone is exceedingly rare and occurs so seldom in ordinary surgical practice that its occasional observation merits particular interest. The experience of Martin[1] affords especially impressive evidence of the infrequency of the condition. A questionnaire which he addressed to a number of prominent surgeons of America elicited replies which indicated that among approximately half a million operations performed by them there were only sixteen instances of intestinal obstruction due to gallstones, or an average of one case in about 30,000 operations. In England, Mayo Robson[2] discovered four cases among 80,000 patients in four large hospitals. One infirmary recorded a single instance of intestinal obstruction by a gallstone in 50,000 admissions of patients. Barnard[3] found eight cases resulting from gallstone among 360 cases of intestinal obstruction encountered during a period of eight years in the principal hospital of London. Finally, a survey conducted under the auspices of the British Medical Association[4] revealed that impacted gallstone was the cause of the intestinal obstruction in less than 1 per cent of all cases of the latter reported within a certain year from seven hospitals.

A perusal of available literature on the subject shows that the terminal portion of the ileum, where the latter becomes narrower in the direction of the ileocecal valve, is the site of predilection of obstruction by gallstone, the duodenum and the jejunum, respectively, being less frequently obturated; while the colon in general and the sigmoid flexure specifically are apparently almost never affected. Thus, among fifty-two cases collected by Courvoisier[5] in 1890, the ileum was obstructed in thirty-three, the ileocecal valve in nine, the duodenum in eight and the sigmoid flexure in only two. In 1914, Wagner[6] prepared a tabular summary of 148 cases previously reported by various writers. Of these, eighty-one involved the ileum (fifty-three its terminal portion), thirty the jejunum, and nine the duodenum, while in fifteen the site of obturation in the small intestine is not stated. The colon was invaded in only thirteen of these cases but no instance of obstruction of the sigmoid flexure is adduced. A careful examination of contributions to the literature since the date of publication of the comprehensive monograph by Wagner[6] has failed to reveal a single reference to the sigmoid flexure as the location of the disturbance.

Individuals in the latter decades of life are particularly liable to this form of intestinal obstruction. The proportion of female to male patients is estimated widely at from 15:1 and 3:1, respectively, in contrast to the incidence of gallstones in women and men which is assumed to occur in the approximate proportion of 2 or 3:1.

According to statistics compiled by Wagner,[6] the mortality from ileus due to gallstone ranges from a maximum of 92 per cent to a minimum of 23 per cent, the latter figure relating exclusively to deaths from complications which followed extraction of the stone. Two major factors are believed to account for the excessively high general rate, namely, the advanced age at which patients undergo operation and the delay which is sometimes inadvertently allowed to occur between the onset of the obstruction and the institution of the appropriate

surgical procedure for its relief. It is the consensus of opinion of experienced surgeons that the prognosis is most favorable

FIG. 1. Large gallstone which produced obstruction of the sigmoid.

when an operation is performed not later than the third day following the adoption of even a presumptive diagnosis.

Three possible portals of entry of gallstones into the gastrointestinal tract have been demonstrated and described: (1) A fistula between the gallbladder and the intestine resulting from antecedent cholecystitis, cholelithiasis, ulceration and erosion, with subsequent production of pericholecystitis and formation of adhesions between the gallbladder or gallducts and the adjacent viscera. While the perforation which develops within these adhesions is most frequent between the gallbladder and the duodenum, fistulae may occur also in the ileum as well as the large intestine. (2) A fistula of the choledochus into the duodenum. (3) Passage through the intact common duct and thence into the duodenum. It has been found that most gallstones enter by way of a fistula between the gallbladder and the duodenum. Among thirty fatal cases reported by Courvoisier,[5] twenty-eight resulted from cholecystoduodenal fistula, and two from fistula between the gallbladder and the colon. Of seventy cases contributed by Murphy and cited by Moore,[7] in which the route of the gallstone was traced, entrance occurred via a fistula between the gallbladder and the duodenum in thirty-six, the gallbladder and the ileum in twenty-five, the common duct and the duodenum in seven and the duodenum and the colon in one. However, of the several modes of invasion, passage into the duode-

num through the intact common duct is the least frequent, although in extraordinary instances ileus from gallstone has occurred without evidence of biliary fistula. In a classic example quoted by Beam[8] and credited to Morgagni the common duct was dilated to the approximate size of the stomach by gallstones.

A consideration of the precise etiology of intestinal obstruction by gallstone is of paramount importance for its differential diagnosis from the other more familiar varieties. Since ileus caused by gallstone results from actual mechanical obstruction of the lumen of the bowel associated with spastic contraction of the muscular fibers of the latter, following relaxation of spasm and gradual migration of the stone along the intestine, the usually persistent symptoms of pain, vomiting and constipation which accompany the other forms of the disorder often assume a definitely intermittent character. Partial occlusion of the lumen by the gallstone may permit the escape of gas and distention and interference with the supply of blood may fail to ensue as in instances of complete obstruction. An antecedent history of cholelithiasis is indispensable for the establishment of even a provisional preoperative diagnosis of ileus due to gallstone. Unfortunately, the anamnesis rarely reveals evidence of previous disease of the gallbladder, although even if it does so the occasionally considerable interval which may have elapsed from the occurrence of the cholelithiasis to the onset of the ileus may obscure the relationship between the two incidents. Radiography sometimes yields shadows suggestive of gallstones, and in the absence of the history referred to may afford the sole basis for a diagnosis prior to operation. However, Gilman[9] warns that the use of opaque material administered by mouth may precipitate a condition of complete obstruction. As in other types of intestinal obstruction the white cell count is usually elevated but is not likely to be as high as in obstruction due to strangulation. Icterus seldom manifests itself, although it is noted when the

stone passes through the intact common duct. According to Powers,[10] there is usually no marked local tenderness but sensitiveness below the right costal margin in the region of the gallbladder is indicative of recent perforation, while generalized abdominal spasm points to general peritonitis.

The prognosis of ileus due to the presence of gallstone depends primarily upon early diagnosis and prompt surgical intervention. In this connection it should be remarked that very often patients exhibit intermittent obstructive symptoms which frequently increase in severity with recurrent exacerbations until complete obstruction occurs. The possibility of peritonitis constitutes an additional hazard of delayed operation. Vidgoff[11] attributes the relatively high mortality to the fact that the majority of patients are not operated upon before five to eight days after the onset of the obstructive symptoms. Balch[12] contributes an instructive comparison of figures for mortality according to duration of obstruction prior to operation. In his group of seventeen cases, only one of eight patients operated upon after the third day of obstruction survived, while of nine patients who underwent an operation during the first three days only four died.

It has been estimated that approximately 50 per cent of patients with ileus resulting from gallstone recover without operative aid, the stone being gradually propelled onward through the small bowel into the colon and outward by way of the rectum. Courvoisier[5] asserted that seventy of 125 of his patients were cured spontaneously by passage of the stones per anum. In the series presented by Wagner,[6] ninety-three patients passed the stone by rectum, 159 were operated upon and eighty-two died without operation. But these infrequent instances of recovery under expectant treatment should not be accepted as proofs of its efficacy. Surgery has always been and is still the universally recognized means for the relief of ileus from all causes. The condition of the patient, the degree of obstruction, the extent of the toxemia and

the time of intervention are cardinal factors in the determination of the particular operative method which is to be employed. Enterotomy is preferred by most surgeons when only mild toxicity is present. The stone is carefully manipulated past the point of obstruction, the bowel is incised along its longitudinal axis above the stone and the latter is extracted. The bowel is thereupon sutured transversely in two layers of gastrointestinal sutures and the abdomen is closed without drainage. The segment of the bowel which contains the stone should be lifted out of the abdominal cavity and walled off prior to incision. However, if the obstruction is complete, the toxemia profound and the general state of the patient otherwise grave, the risk entailed by a protracted operation should be seriously contemplated. Here simple enterostomy with removal of the stone and establishment of adequate drainage is indicated. The stone should be extracted through a transverse incision in order to avoid the constriction of the intestinal lumen which occurs when a longitudinal incision is closed and inverted. Transverse closure is advocated when removal of the stone is effected by means of a longitudinal incision. Saline solution should be administered subcutaneously and intravenously both before and after operation to compensate for chlorides lost by vomiting.

When a faceted stone is encountered at operation, it is quite probable that there is another stone higher in the intestinal tract which should be extracted prior to closure. If the condition of the patient warrants it, a search should be conducted for this second stone, whose discovery and removal during the initial operation may render unnecessary a subsequent surgical procedure designed for the relief of secondary obstruction.

The following case from my own practice apparently represents the third instance of obstruction of the sigmoid flexure by a gallstone thus far recorded in the literature:

A married woman, aged 64, with a past general medical history of typhoid fever and

malaria, when seen on January 17, 1940, related that two and a half years previously she had been admitted to the hospital with symptoms suggestive of cholecystitis and had been treated there for alleged peritonitis localized in the right upper quadrant. Following her discharge she had experienced recurrent digestive disturbances and symptoms referable to the gallbladder. On the morning of January 14, 1940, she had been awakened by an urge to defecate, whereupon she became violently nauseated and commenced to vomit. Vomiting had since occurred from four to five times daily. Enema elicited only a small amount of feces and gas. Examination revealed a robust, somewhat obese female with a firm and moderately distended abdomen. There was no definitely localized tenderness, but general discomfort was manifested on palpation with some resistance to pressure in the left lower quadrant. Urinalysis showed 3 plus albumin, a few red blood cells, some white blood cells, hyaline casts and an occasional granular cast. Examination of the blood revealed 4,850,000 red cells and 11,400 white cells, with 96 per cent of hemoglobin. A tentative preoperative diagnosis of intestinal obstruction was based upon the failure of the bowel to empty itself properly, nausea, vomiting and abdominal distention. Malignancy of the sigmoid was for a time suspected but was ruled out by the absence of bloody stools and purulent discharge from the rectum.

On January 19, 1940, an operation was performed under spinal anesthesia with pantocain. The abdomen was opened by a median subumbilical incision, and the distended ileum, ascending, transverse and descending colon were exposed. Following the delivery of the sigmoid into the wound, a well defined foreign body present in the former was palpated and identified as a large gallstone. Propulsion of the stone along the sigmoid and into the rectum appeared impracticable, since it was feared that a forceful effort to pass the stone over the promontory might result in laceration of the bowel and involve the necessity for an operation in the rectosigmoid region, a procedure which would have proved difficult because of the obesity of the patient. Exploration of the right upper quadrant revealed a definite mass, obviously a fused pyloric end of the stomach or the duodenum with the gallbladder. There were numerous adhesions around this region, and apparently a fistula (either a cholecystogastrostomy or a cholecystoduodenostomy) existed between the gallbladder and the gastrointestinal tract. Sigmoidotomy was performed and a large gallstone was extracted. The longitudinal incision was thereupon closed with No. 00 chromic catgut and interrupted silk, a Penrose drain was provided and the abdomen was closed in the usual manner.

The postoperative course was uneventful, except for a slight infection of the wound which healed completely, and a transient psychosis of presumably toxic origin, similar in character and course to that said to have been experienced during hospitalization for the attack of disease of the gallbladder two and a half years previously. The patient was discharged in excellent condition on February 17, 1940, approximately four weeks after the operation.

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CARCINOMA OF THE AMPULLA OF VATER*

THREE CASES OF TRANSDUODENAL RESECTION

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AND

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INDIVIDUAL experience with this disease is necessarily limited by rarity. In large series of autopsies, its incidence lies somewhere between 0.03 and 0.06 per cent.[1,5,8] Several authors, notably Cohen and Colp,[4] Whipple,[15] Hunt and Budd,[9] and Allen,[1] have recently reviewed carefully and exhaustively the scattered records and previous reviews of other small series of radical resections with complete clinical discussions.

Twenty-two resections had been done in 110 cases collected by Outerbridge.[13] The reported resections have been conservatively estimated to represent less than 20 per cent of the cases of periampullary carcinoma.[9] Ninety-six patients in 193 case reports reviewed by Allen[1] had no operation, or had exploratory or palliative operations only, leaving ninety-six cases of radical resection. Unfortunately for adequate surgical treatment, the high grade pancreaticobiliary insufficiency produced by these obstructing tumors is extremely disproportionate to their malignancy and extent. Hanot's term, "pancreatico-biliary pylorus" aptly suggests the analogy with the stomach in regard to early obstruction and symptoms. By reason of its rarity and of diagnostic difficulties these tumors are undoubtedly frequently confused with the much more highly malignant, but later obstructing carcinomas of the head of the pancreas. It has been noted often, beginning with Crohn,[6] that many of them found at autopsy as the cause of the symptoms and of death, are small, freely movable, resectable tumors without metastasis.

Our cases presented no clinical features by which they might be distinguished from carcinomas of the head of the pancreas or stone impacted at the ampulla, except the finding of blood in the stools. Denechau[7] believed that biliary obstruction, indeterminate intestinal bleeding and intractable diarrhea might be the clue to the diagnosis. Crohn[6] stated that not only the entire absence of bile but also of pancreatic ferments in the duodenal contents indicated the ampulla as the site, blood being the clinching factor. Hunt made a strong plea for early exploratory operation in all cases of obstructive jaundice in which definite contraindications are absent. Cohen and Colp[4] quoted Petren's opinion that the first three weeks of obstructive jaundice was the optimum time for exploratory operation. Remissions may occur because of ulceration of the tumor.

CASE REPORTS

Case i. Mrs. N. F., No. 1690335, a housewife, aged sixty-three, was admitted to Cook County Hospital December 12, 1937, with complaints of progressive jaundice, and dull boring epigastric pain for four weeks, during which she lost fifteen pounds in weight. The pain was aggravated by eating and somewhat relieved by vomiting two or three times daily for the previous three weeks. Eight months before she had been in the hospital for three weeks with jaundice, chills, fever, dull, boring, nonradiating pain in the right upper quadrant, and a loss of weight, rapidly regained after the disappearance of the jaundice. She had felt fairly well in the "free interval."

Physical examination showed an intensely icteric, emaciated white female who had a slightly enlarged smooth liver with a sausage-

fusions controlled what seemed to be a duodenal obstruction. Occasional vomiting occurred until the twenty-second day. She was discharged

Duodenal mucosa

Common bile duct

Pancreatic duct
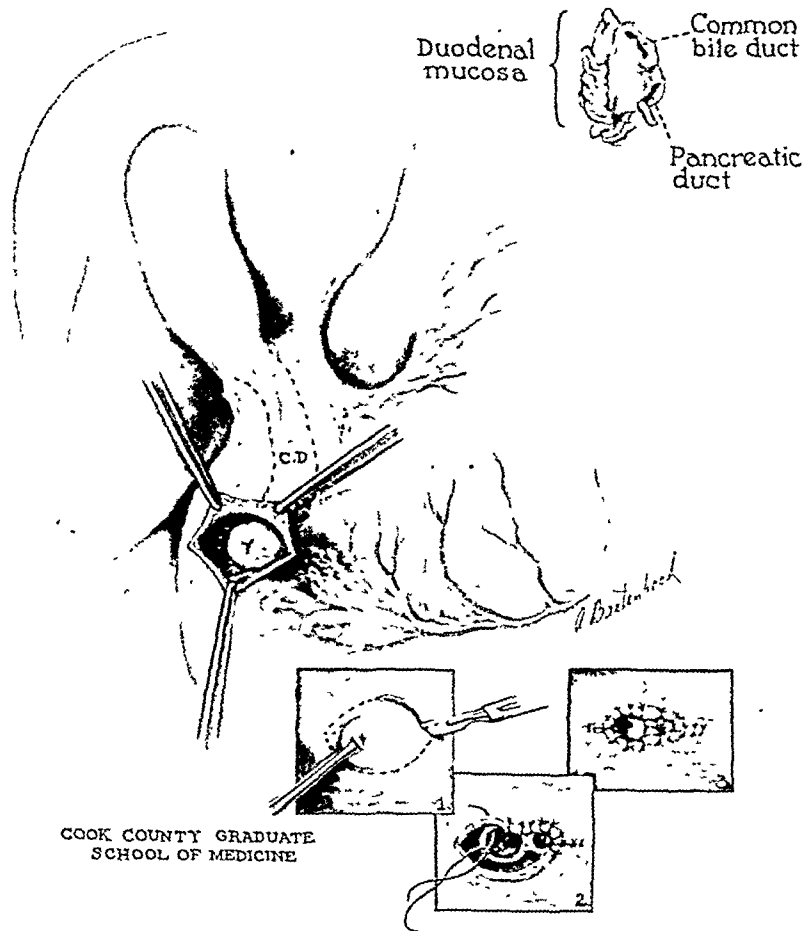
C.D

COOK COUNTY GRADUATE SCHOOL OF MEDICINE

FIG. 1. Case 1. Appearance at operation.

shaped, tense, tender mass below it. The urine was negative except for bile. Two of eight consecutive stools contained occult blood. The icteric index was 80. The diagnosis was obstructive jaundice, probably malignant.

At operation, January 8, 1938, (R. W. M.), a large, tense, gallbladder, an enormously dilated common duct and a rounded, firm mass in the posterior wall of the second part of the duodenum were found. The tumor was resected with adjacent duodenal wall, ampulla, common and pancreatic ducts. (Fig. 1.) The cut margins of the common and pancreatic ducts were united with each other and the duodenum. No drainage was introduced.

On the eighth day she began to vomit after having taken fluids well for four days. A duodenal tube, intravenous fluids and three trans-

February 20, 1938, feeling well, eating without distress and gaining weight. She remained well until April, 1939, when she noted weakness and anorexia. After three weeks, chills, fever and vomiting occurred, followed by jaundice, itching, occasional vomiting, clay colored stools and loss of weight. On readmission to the hospital, three weeks after onset of the jaundice, the coagulation time was seventeen minutes, bleeding time two minutes. The icteric index was 41; the gallbladder did not fill. There was no blood in the stools and the diagnosis was recurrence.

At operation, August 23, 1939, (R. W. M.), a distended gallbladder and common duct were found. There was tight constriction at the site of the anastomosis but no induration or glands felt. The diagnosis was anastomatic stenosis and cholecystgastrostomy was done. The jaun-

dice was noticeably clearing in four days, the course was uneventful and she was discharged on the fourteenth day, relieved of all complaints.

The preoperative diagnosis was impacted common duct stone.
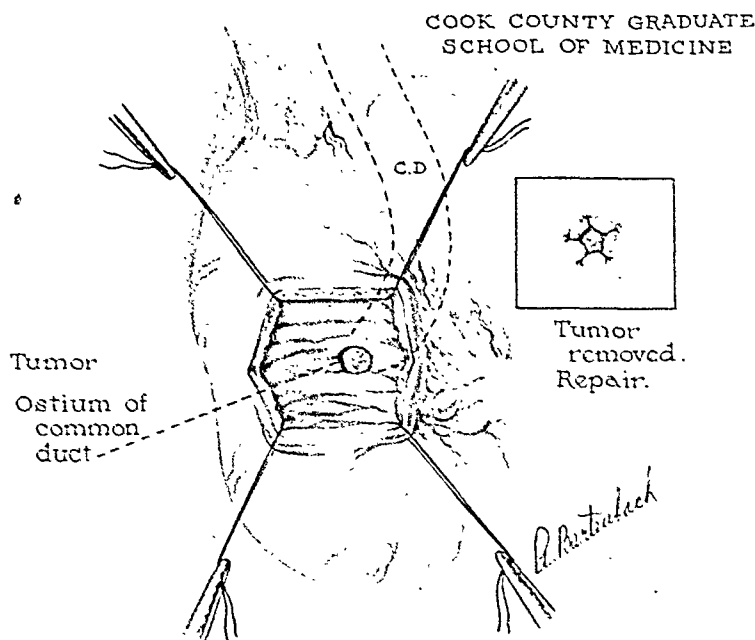
At operation, July 20, on another surgical

FIG. 2. Case II. Appearance at operation.

On March 1, 1940, she stated that she had "indigestion," had to be careful of her diet, but had had no jaundice and had maintained her weight.

CASE II. E. W., C. C. H., No. 37391, steam table attendant, married, aged fifty-five, was admitted to the hospital July 4, 1939. He complained of jaundice and itching for eight months, loss of fifty-eight pounds in eight months, pain in the right upper quadrant for six months and weakness and dizziness for one month. He was well until December, 1938, when jaundice began insidiously. Dull, boring pain was first noted two months later. Even though losing weight his appetite remained good until one month before admission, when he began to have much lighter colored stools and dark urine. During this last month he lost ten pounds, and weighed only 100 pounds. His past history was negative.

Physical examination revealed a well developed, poorly nourished white male neither acutely ill nor deeply jaundiced. His liver was palpable four fingers below the costal margin and was smooth and firm. Microscopic blood was found in three consecutive stools which contained small amounts of bile. The urine contained urobilin and bile. The icteric index was 75, blood cholesterol 284 mg. per cent and cholesterol esters 83 mg. per cent on July 7.

service, a distended gallbladder and common duct were found. Both were drained. The duodenum was negative to palpation; it was not mobilized. The fistula remained open until the twentieth postoperative day. Following closure jaundice developed rapidly with a tender, visible and palpable swelling of the gallbladder. The Junior intern, noting these features and continuance of the blood in the stool, made a diagnosis, by exclusion, of carcinoma of the ampulla of Vater.

Operation was performed August 15 (L. R.). The thin walled, distended gallbladder was covered with adherent omentum, stomach and duodenum. The common duct was not identified. There were two small abscesses between the adherent stomach and thickened hepato-duodenal ligament. Nothing abnormal was felt through the second portion of the duodenum. After mobilization, a small nodule was felt at the region of the papilla. Transverse anterior duodenotomy disclosed a round, slightly ulcerated, smooth nodule, 5 mm. in diameter, plugging a dilated opening. The pedicle was just inside the ampulla and the tumor had prolapsed through. A large probe passed it easily and allowed a free flow of green bile.

The circular resection included duodenal wall, tumor and ampulla. The pancreatic duct

was not seen. The common duct was 1.5 cm. in diameter. It was sutured to the duodenal defect.

Completely clear of jaundice, and the wound

There were no masses felt; the liver edge was impalpable. Rectal examination was negative.

On April 16, 1940, he returned to the hospital

COOK COUNTY GRADUATE
SCHOOL OF MEDICINE

Ostium of common duct

Tumor

Ostium of pancreatic duct

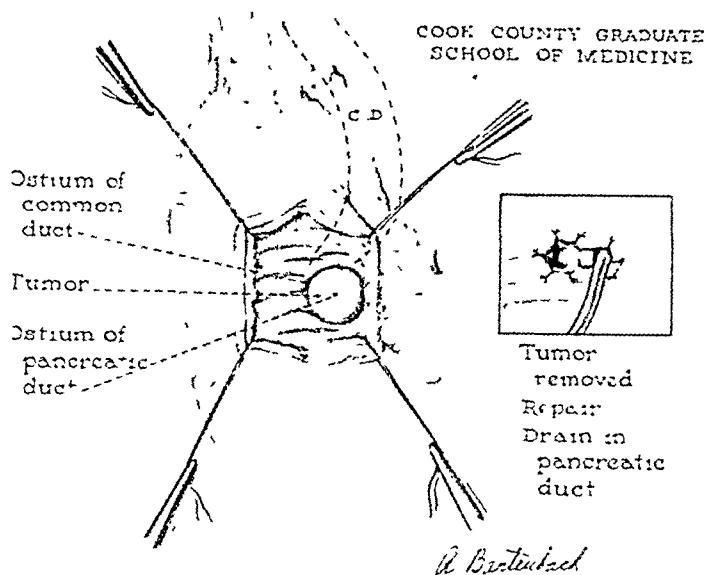Tumor removed
Repair
Drain in pancreatic duct

FIG. 3. Case III. Appearance at operation.

FIG. 4. Case I. Section through entire tumor.

healed, the patient, weighing 131 pounds, was discharged on the sixteenth day. Just before and just after discharge he had eight deep x-ray treatments through two portals.

On April 1, 1940, he weighed 155 pounds, looked well, felt well and stated he was eating everything his toothless gums could handle.

complaining of loss of appetite, epigastric distress, chills and fever, itching of the skin and constipation for two weeks. He had two chills followed by fever on the ward. The only positive physical finding in a complete work-up was a distended, tense, nontender gallbladder. No evidence of metastasis was present. Bile was

found in the urine and stools. There was no blood in the stools. The prothrombin clotting time was 100 per cent. The diagnosis was cicatricial obstruction at the site of anastomosis with early ascending cholangeitis. Cholecysto-jejunojejunostomy by Whipple's method was done April 23. There was no palpable evidence of local recurrence or distant metastasis. Convalescence was uneventful. The jaundice had disappeared on the fourth day. The patient stated that all his symptoms had been relieved when discharged on the sixteenth day and that he felt better than for the two or three months before operation. He was operated upon on September 20, 1940, for severe duodenal obstruction. No glandular or hepatic metastases were felt. He has remained well except for occasional intestinal distress; on February 10, 1941, x-ray showed a well functioning stoma.

CASE III. S. S., C. C. H., No. 50672, a waiter, single, aged fifty-five, was admitted to the hospital September 6, 1939, with complaints of jaundice, bloating and belching, and weakness for four weeks. Sharp right upper quadrant pain had been present for three weeks, radiating to both shoulders. He had lost ten pounds in the last two weeks.

Physical examination revealed a well developed, emaciated, deeply jaundiced, white male, appearing ten to fifteen years older than his stated age. He had a palpable, tender gallbladder. Bile was absent in the stools. The chemical test for blood was positive in five of eight consecutive stools. The icteric index was 50. The diagnosis was carcinoma of the pancreas or of the ampulla of Vater.

Operation was performed on September 29, (L. R.). A tense, thin walled, distended gallbladder and dilated common duct were found. There were firm small glands at the junction of the hepatic and cystic ducts and at the hilum of the liver, but no nodules in the liver. The pancreas was uniformly firm and enlarged. There was a 1.3 cm., hard, eroded, disc-like mass in the posterior duodenal wall, mesial to the common duct opening. (Fig. 3.) Wirsung's duct opened in the middle of this. The surrounding duodenal mucosa was edematous. Laterally, the mass overhung and obstructed the opening of the common duct, from which dark green bile flowed when a probe was passed. The mass was resected with surrounding duodenal wall and the lower portions of the

separate ducts. These were sutured to each other and anastomosed to the duodenum, and 3 cm. of a No. 10 catheter placed in Wirsung's duct with the end hanging free in the duodenum.

The jaundice disappeared slowly. The gallbladder drain came out on the sixteenth day at which time there was still slight jaundice but much bile in the stools. Deep x-ray therapy was begun and he was discharged from the hospital thirty-five days after operation, having gained twelve pounds.

On May 24, 1940, he looked well and was not jaundiced. He had gained ten pounds since discharge. He could not eat fried or greasy foods without distress. Examination of the abdomen was negative, the liver margin was not felt and he stated that there was no pain. The stool contained no undigested fat nor blood and was well colored. Rectal examination was negative. He died September 25. Massive metastases into the mediastinum had been shown by x-ray. No autopsy was performed.

PATHOLOGIC REPORTS

Case I. N. F. Figure 4 is a section through the entire specimen. Sections are shown from the most proximal portion of the common duct and serially from the tumor proper in the ampulla of Vater. In the former section, the common duct was lined in places by a single layer of columnar epithelium showing slight papillary projections into the lumen. Embedded in the wall and particularly in the submucosa were large numbers of gland-like structures lined by tall columnar epithelium, in places several layers thick, with not infrequent mitotic figures. Some were atypical. These glands were surrounded by fairly dense accumulations of plasma cells, lymphocytes and a few polymorphonuclear leucocytes. Sections through the ampulla of Vater revealed numerous, irregular, gland-like structures (Fig. 5A) containing numerous atypical mitotic figures, and encircling and invading the wall of the pancreatic duct forming the polypoid structure already described. The stroma was heavily infiltrated with eosinophiles and lymphocytes. Some of the tumor glands were distended by a large amount of mucoid material.

Diagnosis. Mucus producing adenocarcinoma of the ampulla of Vater with invasion of the common bile duct and the pancreatic duct.

Case II. E. W. Sections at different levels revealed a portion of the tissue to be lined by duodenal mucous membrane. On tracing the cells of the glands were several layers thick, and scattered atypical mitotic figures were seen. This tumor was associated with a moder-

FIG. 5. A, Case I. Section through ampulla of Vater. B, Case II. Section at ostium of common duct. C, Case III. Section through pancreatic duct.

mucous membrane as it approached the common duct opening it was lined by low columnar epithelial cells which infiltrated the submucosa and formed small and large irregular glands lined by cells which contained irregular hyperchromatic nuclei. (Fig. 5B.) In places the lining

ate desmoplastic reaction which was heavily infiltrated by numerous lymphocytes and plasma cells. In one area the sphincter muscle of the common duct was infiltrated by tumor.

Diagnosis. Adenocarcinoma of the orifice of the common duct.

Case III. S. S. The tissue, 13 mm. in diameter, was button-shaped and had a small central depression 1 mm. in diameter. The free surface was granular. The thickest portion of the mass was 0.05 cm., the thinnest portion measured 0.03 cm. and encircled the thick portion from 2 to 3 mm.

Sections were taken through the entire thickness. The thin peripheral zone was lined by a mucous membrane characteristic of the duodenum. The thicker portion of the tissue was lined by irregular gland structures having numerous papillary projections, whose cells were large and several layers thick, with elongated and slightly irregular nuclei (Fig. 5c) and mitotic figures. The tumor tissue in places extended along the duct and invaded the muscle fibers surrounding it.

Diagnosis. Papillary adenocarcinoma of the pancreatic duct.

COMMENT

1. Complete work-up should be started on the jaundiced patient as soon as the history is written, and administration of vitamin K, bile salts, increased glucose, and blood, (as available), should begin at the same time.

2. X-ray, at present, offers little diagnostic help. The difficulties in showing such defects of the posterior wall of the duodenum as may be caused by these small tumors are enormous. No matter what methods are used, the anatomic irregularities and the height of the valvulae conniventes of the second portion are almost insuperable obstacles to good visualization. By the time the defects are visible the tumor is usually inoperable.[11]

3. Obstructive jaundice being demonstrated, particularly in the absence of pancreatic ferments in the duodenal contents and the presence of blood in the stools, surgical exploration should wait only upon adequate preparation of the patient.

4. In addition to the usual exploration of the gallbladder and ducts, palpation of the duodenum and pancreas, the duodenum should be mobilized and palpated, or opened, or both. It should be remembered that stones are an incidental finding in about 20 per cent of cases of this disease.

5. For the small, early tumors one-stage local resection seems still to be the procedure of choice. If the glands felt in Case II are malignant, the two-stage procedure could be no more useful than the operation performed. Hunt's patient, the case reported in 1935, lived twenty-seven months and died of extensive mediastinal and retroperitoneal metastases.[10] He has since twice performed the same operation for obstructing growths of the ampulla, one benign and one malignant. Both patients are alive and well, the one with carcinoma twenty-two months after operation. Emphasizing that he had had no experience with Whipple's[15] operation, he questioned whether extensive operation for carcinoma of the ampulla invading the head of the pancreas will be followed by results sufficiently good to justify its extent.

6. The pancreatic duct may be ligated if necessary. Whipple[15,16] and Brunschwig[2] have demonstrated the physiologic practicability of exclusion of the pancreas with block excision of the duodenum and the head of the pancreas. This two-stage resection is a notable contribution to the surgery of cancers of this region. However, excluding cancer of the pancreas, the remainder metastasize late and the metastases are distant as often as local. If the size of the growth and the extent of invasion of duodenum and pancreas indicate the futility of attempting one-stage local resection, the first stage of Whipple's operation should be done. If time is extremely important, it seems that the two anastomoses could be accomplished rapidly with Murphy buttons.

Excellent palliation with little danger of ascending cholangeitis may be expected from the cholecystojejunostomy described by either Lauwers,[12] Whipple[15] or Brunschwig.[2] One might then consider unhurriedly the advisability of undertaking the second stage. Adequately to evaluate and compared the one- and two-stage procedures, Whipple[16] predicated a sufficient

number of cases with five-year follow-ups.

7. Longitudinal anterior duodenotomy with transverse closure is suggested as compensation for the posterior resection.

CONCLUSIONS

1. Three instances of successful transduodenal resection of periampullary carcinoma with re-implantation of the ducts are recorded. Two required subsequent internal biliary drainage because of stenosis at the anastomoses.

2. Earlier and more frequent exploratory operation in obstructive jaundice is urged.

3. Duodenal mobilization and incision are advised if the history and course are suggestive, and no cause for the obstruction found by the usual palpation and probing.

4. Choice of operative procedure is discussed.

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CAUSALGIC BACKACHE

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JUDOVICH and Bates[8] have called our attention to the fact that low back pain may originate in the dorsolumbar area. In osteopathic literature the authors have mentioned that a pelvic tilt may cause backache due to a primary short lower extremity. This condition they treat by an elevation within the shoe and by osteopathic manipulation.

One type of back pain involves the lumbar muscles and especially the quadratus lumborum. Here, pain radiates along the twelfth rib due to twelfth dorsal and first lumbar nerve irritation and a clinical picture of asymmetrical muscle imbalance occurs. This group of cases comprises a definite clinical entity which can be separated from the vast group of patients suffering from back pain. The treatment is simple and effective.

This type of backache, produced by muscle imbalance, causes subjective symptoms because the imbalance, together with the muscle spasm, increases the tension within the quadratus lumborum fascia, producing direct pressure on the twelfth dorsal and first lumbar nerves. The irritation is manifested by pain with radiation along the course of these nerves. (Fig. 1.)

The trunk is maintained erect in equilibrium by the abdominals and quadratus lumborum muscles in front and the sacrospinalis muscles behind. Overaction or weakness of any group of these muscles will allow contractures to develop.

The abdominal muscles, due to lack of use, become weakened and the overworked sacrospinalis muscles become contracted with an increase in the lumbar lordosis. The pelvis, lacking the stabilizing effect of the abdominal muscles then inclines more anteriorly. Injury, a toxic focus or chronic stress, may cause the quadratus lumborum to become irritated, resulting in spasm. Contraction of the quadratus lumborum causes the last rib on the same side of the spine to deflect downward at a more acute angle. As the twelfth rib is drawn downward it also rotates forward, giving relatively a greater distance for the twelfth dorsal nerve to traverse from the intervertebral foramen to the subcostal groove. As a direct result of this shift there is produced increased tension in the nerve sheaths. In an effort to relieve the pain thus produced, the patient will assume a position of asymmetrical muscle imbalance and functional scoliosis appears. Following this uneven distribution of body weight a pelvic tilt results with abduction of the lower extremity on the side of the low crest and adduction of the lower extremity on the side of the high crest.

Other muscle changes then occur. On the abducted side, the thigh rotates internally at the acetabulum and the foot pronates with a valgus of the heel. On the adducted side, the thigh shows little or no internal rotation and the foot little or no pronation. Another factor in maintaining the pelvic tilt is the pull of the pronated foot and internal rotation of the femur of the abducted extremity. (Fig. 2.)

We have chosen to label this syndrome, for want of a more appropriate term, causalgic backache. Causalgia, or pain of a burning nature, describes briefly the sensation these patients experience.

EXPERIMENTAL PRODUCTION OF CAUSALGIC BACKACHE

One of us, in an effort to prove the validity of this theory, made an experiment

Fig. 1. Cutaneous distribution of twelfth dorsal and first lumbar nerves.

in an individual who had no history of previous back complaints. Preliminary clinical and Roentgen examinations were negative. An elevation of ³⁄₄ inch was added to the heel of the left shoe, and was worn at all times. A clinical examination was made with the adjusted shoes on. There was noted a pelvic tilt with the right side inclined downward. The spine showed a right dorsal, left lumbar scoliosis. The right thigh was abducted and the left thigh was adducted.

On the first day of the experiment there was a sensation of walking uphill on the adducted extremity. Most of the weight was borne on the abducted extremity (right), while the patient was walking and standing. (This was proved by having him stand with each foot on a separate spring balance.)

A notation in the diary on the third day disclosed that considerable aching was experienced deep in the buttocks. By this time it was impossible for the subject to walk with comfort unless the entire right lower extremity was internally rotated.

After one week, there was a sense of tightness and pulling in the dorsolumbar area on bending over; especially was this true on any attempt to straighten up. At

this time definite tenderness was present paravertebrally in the dorsolumbar area and along the right twelfth rib. The right sacrospinalis muscles were spastic.

Fig. 2. Diagrammatic representation of radiographic findings.

Following three weeks' activity in this position, subjective pain was present radiating around the right side at the level of the twelfth nerve distribution. Hyperesthesia was present in the groin and along the right side of the chest. Night pain in these areas had been present for some time.

After the elevation was removed and exercises instituted, the symptoms disappeared in two weeks.

History. The history of these patients is quite characteristic. They have suffered for years with a pain in the low back area. They localize it, however, by placing the hand over the crest of the ilium or midlumbar region. Pain is unilateral. If pain is right-sided, many of the patients have had appendectomies, gall-bladder surgery, or urologic instrumentation without relief. The pain is described as aching, burning, tearing apart, boring, or stabbing in nature. These patients are unable to get comfortable on going to bed and they twist and turn for ten to twenty minutes to get relief. This pain awakens the patient at

TABLE I

Case	Sex	Age	Chief Complaint	Duration of Symptoms	Type of Individual	Previous Treatment	Elevation of Heel, Inches	X-rays Positive for Syndrome	Osseous Lesions	Foci	End Result
A. G.	M.	48	Pain right back	2 years	Slender	Physiotherapy	1/2	Yes	None	Teeth	No pain. Returned to WPA work
C. P. H.	F.	38	Pain right back and groin	4 years	Heavy	Physiotherapy, foci removed, support	1/2	Yes	None	None	Cured
L. M.	F.	40	Pain right back and groin	5 years	Slender	Kidney studies, fracture 1st. lumbar vertebra, 1930	5/8	Yes	None	Teeth	Cured
A. R.	M.	28	Pain right back	1 year	Slender	Physiotherapy	1/2	Yes	None	None	Cured
M. R.	F.	35	Pain left groin	10 years	Slender	Foci removed	1/2	Not done	....	Teeth	Relieved
M. C.	F.	39	Pain right lumbar area	6 years	Slender	Laparotomy, physiotherapy	1/2	Yes	None	None	Cured
L. E.	M.	39	Pain right low back	?	Slender	None	5/8	?	Scoliosis	None	Cured
E. B.	M.	41	Pain right low back	4 months	Slender	Physiotherapy	5/8	?	None	Teeth	Relieved
L. E.	F.	41	Pain right groin and short ribs	3 years	Slender	Urological studies, physiotherapy	5/8	Yes	None	None	Did not carry out treatment
A. P.	M.	30	Pain in left upper back	8 months	Slender	Physiotherapy	3/4	Yes	None	None	Relieved
A. A.	M.	45	Pain right short ribs	4 months	Slender	Physiotherapy	1/2	Yes	None	None	Relieved. Returned to WPA work
R. B. H.	F.	40	Pain right short ribs	9 years	Slender	Physiotherapy, Ober operation	1/2	Yes	None	None	Cured
A. T.	M.	30	Pain right groin	1 year	Slender	Physiotherapy	1/2	Refused	....	None	Unknown
H. H.	F.	44	Pain right groin	1 year	Slender	Physiotherapy	1/2	Refused	....	None	Refused treatment
R. B.	M.	40	Pain right low back radiating to groin	1 year	Slender	Physiotherapy	3/4	?	None	Teeth	Cured
E. J.	F.	44	Pain right low back radiating to groin	15 weeks	Slender	None	5/8	Refused	....	None	Relieved
J. G. M.	M.	41	Pain left low back radiating to groin	7 months	Slender	Physiotherapy	1/2	?	None	None	Relieved
D. P.	F.	24	Pain right back radiating to groin	3 months	Slender	Physiotherapy	1/2	?	None	None	Relieved
A. B.	F.	20	Pain right low back	3 months	Slender	Physiotherapy	1/2	Yes	None	None	Cured
R. D.	F.	39	Pain left low back radiating to groin	3 years	Slender	Physiotherapy	1/2	Yes	None	None	Relieved
G. L.	F.	33	Pain left low back	4 months	Slender	None	1/2	Refused	....	None	Unknown
H. M.	M.	40	Pain right dorso-lumbar area	1 year	Slender	Physiotherapy	1/2	Yes	None	None	Cured
G. B.	F.	36	Pain right dorso-lumbar area	1 year	Heavy	Physiotherapy	1/2	?	Congenital anaomies	None	Some relief
Dr. P. E.	M.	30	Pain right dorso-lumbar area	2 years	Slender	Lift on heel	5/8	Yes	None	None	Cured
L. L.	F.	37	Pain right upper back radiating to groin	2 years	Slender	Physiotherapy	3/4	Yes	None	None	Cured
H. C. B.	M.	40	Pain right upper back	1 year	Slender	Foci removed	1/2	None	None	None	Questionable
G. R.	M.	35	Pain left low back	4 weeks	Slender	Physiotherapy	1/2	None	....	Teeth	Questionable
G. M.	F.	47	Pain right dorso-lumbar area	1 week	Slender	None	1/2	Yes	None	None	Questionable
M. M.	M.	35	Pain left dorso-lumbar area	3 years	Slender	Various	1/2	Yes	None	None	Cured
Dr. M. L.	M.	36	Pain left dorso-lumbar area	2 years	Slender	None	1/2	Yes	None	Teeth	Cured

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night, it begins near the midline posteriorly and usually radiates anteriorly when he arises. Lying on the hypersensitive skin area produces the night pain. Coughing, sneezing, or missing a step while walking gives severe pain that frequently doubles the patient up. Also, pain may be brought on by bending over the washbasin in the morning or bending over to do any type of work. In addition, there may be radiating pain into the thigh posteriolaterally, over the lumbosacral area, or over the upper gluteal area.

Examination. Examination of all patients reveals spasm of the lumbar muscles of varying degree, with limitation of motion of the spine in all directions. There is an increased lumbar lordosis. Scoliosis is present on standing, but disappears on lying down. The pelvis is tilted and on the low side there is abduction of the lower extremity, internal rotation of the thigh, and marked pronation of the foot. On the high side of the pelvic tilt there is adduction of the lower extremity, little or no rotation of the thigh, and little or no pronation of the foot. (The rotation of the thigh on the low side may be overlooked if the patient is examined with the thighs in external rotation.)

Hyperesthesia to pinching and poking of the skin is present over the cutaneous distribution of the twelfth dorsal and first lumbar nerves. There is tenderness along the twelfth rib, especially at exits of nerve trunks through fascia or muscle. This can be elicited easily by pressing upward on the lower edge of the rib. There is tenderness and hyperesthesia parallel to Poupart's ligament, on the upper inner aspect of the thigh, and over the twelfth dorsal and first lumbar transverse processes paravertebrally.

Leg length should be measured. Elevations of varying thicknesses under the heel of the side of the low iliac crest should correct the pelvic tilt and reëstablish normal posture. The patients will immediately feel more secure in their balance and comment on this fact without questioning.

Treatment. If the heel on the abducted extremity is raised by an elevation sufficient to overcome the pelvic tilt the quadratus lumborum is relaxed, the rib returns to its normal position, the scoliosis is corrected, and the internal rotation of the thigh disappears. Exercises are given to strengthen the abdominal muscles and weaken the sacrospinalis group.

Radiographic Examination. Roentgenograms are taken in the usual manner to rule out any abnormality such as structural scoliosis, arthritis, etc. When causalgic backache is diagnosed clinically, the routine x-ray films are supplemented by special examinations described in detail below. Conversely, this syndrome may be suspected if anteroposterior upright films of the dorsolumbar spine and pelvis show an acute angle of the twelfth rib, low iliac crest, and low femoral head on the same side. (Fig. 3.)

We perform the Roentgen examination as follows:

1. A supine film is made in the anteroposterior projection of the lumbosacral spine including the lower two dorsal vertebrae. It is important that the subject be adjusted on the table so that the spine is straight.

2. A film is made of the same region with the patient in the upright position, using the Potter-Bucky diaphragm. The position of the patient, here too, is important. The shoes are removed and the feet are placed 4 inches apart and parallel. The patient is asked to stand with the weight equally distributed.

3. This examination is optional. The film is taken with elevations varying from $\frac{1}{4}$ to $\frac{3}{4}$ inch in thickness placed under the heel of the side of the low iliac crest. This is done as in 2.

Landmarks. 1. Costovertebral Angle. To determine one side of this angle, a line is drawn between the inferior articular margin and the inferior border of the twelfth rib at the junction of the outer and middle thirds. The other side of this angle is formed by a line drawn between the inferior

Fig. 3. Radiographic examination of typical case; female, aged 34, complaining of left lower abdominal pain and backache for five years. A, supine film, showing equal costovertebral angles, negligible deviation of axis of lumbar and level crests and femoral heads. B, upright film showing acute left costovertebral angle, deviation of lumbar spine towards the right, and low left iliac crest and femoral head. C, upright film with a 1½ inch elevation under the left heel showing a partial correction of the deformities. D, upright film with a ¾ inch elevation under the left heel showing almost complete restitution to normal posture.

articular margin of the twelfth rib and the superolateral margin of the second lumbar vertebra.

2. *Angle of Deviation of the Axis of the Lumbar Spine.* A vertical line is projected from the midpoint of the spinous process of the twelfth dorsal vertebra to the same point of the first sacral segment. A horizontal line is drawn parallel to the bottom of the film through the spinous process of the first sacral segment. The angles formed by these lines are measured. The tilt of the spine, either to the left or right, is expressed in degrees by subtracting the smaller angle from the larger.

3. *Level of the Iliac Crests.* Lines are drawn parallel to the base of the film (or perpendicular to the side of the film) passing through the highest point of each iliac crest. The distance between these two parallel lines is measured.

4. *Level of the Superior Articular Margin of the Femora.* The procedure here is identical with that of 3, the only difference being that the uppermost point of each femoral head is selected as a guide for the parallel lines.

5. *Other Points to Be Noted on the Examination.* (a) Postural scoliosis of the dorsolumbar spine; (b) rotation of the pelvis; (c) abduction and adduction of the femora; (d) internal rotation of the femur on the side of the low crest.

REPORT OF CASES

We have treated thirty cases conservatively. The etiologic factors were: injury to the back in ten; focal infection in eight; and no known cause in the remainder. The pain was right sided in twenty-two cases and left sided in eight. Ages varied from 20 to 48 years. There were fifteen females and fifteen males. The type of individual affected was the slender herbivorous type in twenty-eight cases and the stocky carnivorous type in two cases.

The elevation of the heel was usually ½ to ⅝ inch. The elevation was worn for three to four months and then lowered one-half for three to four more months. Some

patients, on raising the heel, develop pain in the thigh along the adductor muscles on the opposite side and in the gluteal area on the same side. The pain is usually relieved in two to three weeks and the hyperesthesia in six to eight weeks.

Exercises are started when the pain begins to subside and are continued daily for six months.

A typical case history follows:

M. L., male, complained of pain of "raw" nature in the left back, radiating to the lower abdomen just above the groin. This had existed two years. The pain awakened him in the morning. Examination revealed a pelvic tilt to the left, scoliosis of the spine, slight increase of the lumbar lordosis, hyperesthesia over the cutaneous distribution of the twelfth dorsal nerve, internal rotation of the left femur with valgus of the left heel, and no muscle spasm in the lumbar muscles.

SUMMARY

Another concept relating to a specific phase in the backache problem is presented. A mechanical theory based on muscle imbalance is advanced to explain the clinical and roentgen findings. The patients complain of an upper lumbar backache that is aggravated at rest, awakens them at night, and is accompanied by pain that radiates along the last rib and to the groin. The clinical examination reveals an increased lumbar lordosis, postural scoliosis, a pelvic tilt, abduction and internal rotation of the femur on the side of the low iliac crest, and adduction of the thigh on the side of the high iliac crest. There is tenderness and hyperesthesia over the cutaneous distribution of the twelfth dorsal and first lumbar nerves. The treatment consists of elevation of the heel on the side of the low crest and muscle exercises. The roentgenographic examination confirms the clinical findings when the upright films reveal an acute costovertebral angle and a pelvic tilt.

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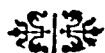
FACTORS IN THE ETIOLOGY OF CHRONIC NONCALCULOUS CHOLECYSTITIS

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THE increasing literature and research on the syndrome of noncalculous cholecystitis shows that the etiology is based on a multiplicity of factors any one or a combination of which may be present in a given case. It is the purpose of this paper to fit together the available information in order to produce a basis on which a therapeutic program may later be constructed. There are three main etiologic factors for consideration in a study of noncalculous cholecystitis: (1) pathologic, (2) mechanical and (3) physiologic.

The extent of the pathologic process in the noncalculous gallbladder is quite variable as described by the classification of Graham and Mackey and the work of Brown. The most frequently occurring chronic pathologic conditions are (1) the minimal lesion, (2) chronic catarrhal cholecystitis, (3) chronic fibrous cholecystitis and (4) cholesterosis. Lahey stated that a fibrosed and contracted gallbladder is not itself the factor which causes stones in the ducts, but rather the conditions that bring about contraction of the gallbladder are the causative factors in the production of stones within the ducts. In 4 per cent of his cases in which stones were removed from the common duct, none were found in the gallbladder.

The pathologic changes in the noncalculous gallbladder range from that of a nearly normal looking organ to one which is extremely infected and fibrosed. Foss, in discussing the needless cholecystectomies, stated that any pathologist possessing a keen imagination and an inordinate desire to support the surgeon may find trouble in any gallbladder. MacCarty stated that diseases of the pancreas, duodenum, common duct, liver, hepatic flexure, transverse colon, stomach and appendix are often in themselves responsible for signs and symptoms which simulate gallbladder disease even though stones are found roentgenologically. In studying a series of 21,523 cases, he found that only 65 per cent of the surgically removed gallbladders contained stones. The presence of pathologic states other than infection in the absence of stones, such as papillomas, malignancies, diverticula, etc., may account for the necessity of surgery. This author stated that since many anatomically and functionally normal gallbladders do contain stones, it is quite likely that the presence of stones alone is not indicative of the necessity for surgery.

In the differential diagnosis of noncalculous cholecystitis, Essenson warned that duodenal ulcer on the posterior wall must be ruled out. Bochus, Shay, Willard and Pessel demonstrated that cholesterol crystals and calcium bilirubinate in bile "B" are pathognomonic of cholecystitis while the cholesterol crystals are highly suggestive of stone formation; when white blood cells are present, infection is indicated. Kanuth found the greatest percentage of cures following cholecystectomy in those cases reported as normal gallbladders. He stated that histologic changes in the wall of the gallbladder are not always an accurate index of the symptoms that the organ has produced or of the benefit that may result from operation. In a microscopic study of the gallbladder in these cases, 25 per cent of the noncalculous group were reported as normal.

Wolfer, in describing the relation of biliary stones and pancreatic regurgitation,

was convinced that acute necrosis, acute gangrenous, and also some cases of chronic cholecystitis with or without stones, are caused by a reflex flow of pancreatic juice into the gallbladder. Wakely stated that dental sepsis and chronic infection of the appendix are important factors in the etiology of gallbladder disease, for there can be little doubt that streptococci may spread via the blood stream from both of these sites to the walls of the gallbladder and set up chronic cholecystitis. Hodges and Lampe explained that major inflammation of the gallbladder occurred in 80 per cent of cases of nonvisualization.

The bacteriology of noncalculous chronic cholecystitis is variable. Aronsohn and Andrews, quoting Magner and Hutchinson, noted that Bacillus coli is the most common organism in the cavity of the gallbladder, while streptococci are found more often in the gallbladder walls. These authors showed that experimental cholecystitis has incriminated the typhoid bacillus, streptococcus, staphylococcus and Bacillus pyocyaneus. They also found that intravenous injection of most strains of bacteria did not cause cholecystitis unless some trauma was added to the wall of the bladder. The injection of bile and bile salts intravenously caused active gallbladder inflammation.

Alvarez and his co-workers found living bacteria in the walls of 57 per cent of the noncalculous gallbladders examined. Blalock obtained positive cultures from 58 per cent of cultures with Bacillus coli being predominant in occurrence and Bacillus typhosus ranking second. In contradistinction to these findings, Nickel and Judd found 71 per cent of strawberry gallbladders and the majority of all chronic cholecystitis cases were sterile unless complicating factors were present. Lowenburg and Mitchell described eight cases of cholecystitis in childhood in which a parasite, Lamblia intestinalis, may have been of etiologic importance.

Kasselberg found in the literature that bacteria of most every type have been reported as cultured from the gallbladder wall and bile. He found that the streptococcus was most often accused while other organisms as staphylococcus, Bacillus welchii, Bacillus coli and Bacillus typhosus were reported. He confirmed the work of Aronsohn and Andrews that injection of bacteria plus trauma will cause cholecystitis. Coller and Jackson emphasized the point that long standing gallbladder infection may cause structural changes in the liver with resultant disturbance in carbohydrate metabolism. Schmidt reported a case of emphysematous cholecystitis caused by Bacillus perfringens. He considered that bacteria found in the gallbladder fall into two groups: (1) head group to which the streptococcus viridans family belong, and (2) the colon group embracing the colon, typhoid, and gas producing organisms. However, Connell stated that sterile bile does not mean a normal gallbladder wall.

Graham stated that in chronic cholecystitis, the liver often presents a microscopic picture practically identical with that of early cirrhosis. Blalock found enlargement of the liver in 22 per cent of his cases. Deaver and Bortz found involvement in 3.5 per cent of noncalculous cases.

Mentzer showed that cholesterosis is present in 37 per cent of gallbladders seen at necropsy and in 22 per cent of surgical specimens. However, he concluded that early cholesterosis may remain for years without progression and therefore surgery is not indicated in all cases.

Judd and Priestley stated that associated removal of the appendix at the original operation did not seem to make any difference in the end results of cholecystectomy. In a study of 346 cases of cholecystectomy, Brown showed that associated appendectomy of 186 cases demonstrated four acute; nine subacute; and 109 chronic appendices, while fifty-nine were normal. Eighteen of the infected specimens contained fecaliths. The operative findings showed thirty with marked adhesions, four with Lane's kink and fifteen were described as retrocecal. Kanuth, in his comparative study, did not

explain his cures in the cases with normal cholecystogram except to state that perhaps incidental appendectomy was responsible. Muller wrote that chronic appendicitis is often difficult to differentiate. Mackey concluded that associated appendectomy did not improve the results of cholecystectomy in his series.

Lawrence and Warren call our attention to the fact that the muscular tunic of the gallbladder is composed of smooth muscle and, therefore capable of hypertrophy. They compared normal gallbladders at autopsy examination with surgically removed organs, and they found the average thickness in normal ones to be .16 mm. compared to .54 mm. in gallbladders showing pathology. Rokitansky-Aschoff sinuses were found three times in the normal ones compared with sixty times in the pathologic organs. These sinuses are usually described as mucosal diverticula or herniations through the muscular layer. The authors found that as cholecystitis increases, muscular hypertrophy becomes more marked until finally erasure of rugal pattern of the mucosa occurs.

MECHANICAL FACTORS

The mechanical factors are variable but may have a direct or indirect effect on the gallbladder. Anatomical variations in the length, caliber and position of the cystic duct may account for clinical symptoms. Congenital variation in the gallbladder structures have been shown to play a part in the etiology of the noncalculous syndrome.

Meeker (1920) analyzed 400 cases in which bands were found in various locations in the abdomen. In this group, 140 cases (35 per cent) involved the gallbladder, 16 per cent bound the duodenum and gallbladder together and 13 per cent involved the liver in addition to these two organs. Three per cent had bands binding the gallbladder and stomach together while another 3 per cent involved the liver as well. Bands occurring between the colon and gallbladder were the most common of all and 47 per cent of 140 cases had cholecystocolic adhesions. Another 18 per cent showed bands involving the liver as well as the foregoing organs. These bands occurring as mechanical factors may involve the duodenum, stomach, liver and colon or any combination of two or more structures without involvement of the gallbladder, yet they produce symptoms characteristic of the noncalculous cholecystic syndrome. Meeker noted that the greatest incidence of bands occurred among women between thirty-five and sixty-five years of age. This compares with Brown's analysis of 346 noncalculous gallbladders in which 92 per cent were found between twenty and sixty years of age, 93 per cent being females. The average age in this whole group was 41.06 years. Meeker stated that when bands involve both the stomach and the gallbladder, pressure and traction downward to the left over the pyloric end of the stomach produces pain in the gallbladder area as well as direct pressure by the finger tips. The diagnosis may be missed or called an ulcer because of this local tenderness.

Meeker found that roentgen examination may demonstrate dilation of the duodenum behind the bands with delayed emptying time. Consideration of this mechanical aspect of pericholecystic bands involving the duodenum may explain Finney's observation of many years ago that in those cases with noncalculous cholecystic syndrome the duodenum was dilated, thin walled and inconstantly associated with changes in the stomach and pancreas. He noted this in patients with a so-called neurotic taint.

That obstruction of the cystic duct may cause the symptoms of cholecystitis has been expressed by Cole. He stated that many cases of so-called cholecystitis are dependent upon obstruction of the cystic duct for manifestations produced and that this theory of the pathogenesis of gallbladder disease by no means can be dropped entirely. Severe angulation stenosis of the duct and anomalous (Heisterian) folds seem to be capable of producing

symptoms which are so serious as to demand relief by surgery.

Brown showed by his analysis of 346 cases that in 124 out of 164 patients showing adhesions about the gallbladder, 75 per cent were cured or improved by cholecystectomy. This exceeds the final results for the entire series by 5 per cent. It has been shown in the past that gonorrhea may invade the pelvis and spread to the upper quadrants of the abdomen to produce "violin string" adhesions. Perhaps this may account for some of the cases in women. However, Meeker considered that bands may be embryonal structures, the result of evolutionary development or toxic processes. Recently, Verbrycke described a new syndrome due to adhesions between the gallbladder and hepatic flexure of the colon. He stated that the gallbladder may concentrate and empty freely but that the weight of the dragging colon produces the symptoms of the gallbladder syndrome. The specific test of this author includes the simultaneous examination by dye and barium meal; if the colon follows the contracting gallbladder after a fatty meal, the shadows remaining close together, the diagnosis is nearly 100 per cent accurate.

General observations of patients in adult life, especially females, show that many begin to take on weight about the age of thirty or comparatively about the time of the greatest incidence of this noncalculous gallbladder syndrome. The parts of the body to show increased fat deposits first are the mesentery and omentum. The increased weight along the intestinal tract, then, could conceivably produce a drag on surrounding organs or tissues to account for a mechanical factor in the production of dyspeptic symptoms. The symptoms could then be intensified in the presence of congenital or anomalous bands or pericholecystic adhesions.

Kruse, in discussing the dyspeptic syndrome, stated that mechanical irritation of the gallbladder against the duodenum may account for the symptoms. Brown theorized that adhesions about the gallbladder could

prevent emptying of the organ by obstructing or binding the organ to the extent of neutralizing its contractile powers required for evacuation.

One finds in the literature much discussion concerning stasis as an etiological factor in gallbladder disease. Actually, the explanation of gallbladder disease on the basis of stasis without qualification is no more accurate than making a diagnosis of rheumatism in a patient with joint or muscle symptoms without making a real attempt at diagnosis. Stasis, however, is a real thing when it is caused by pathological changes in the gallbladder wall or some mechanical factor such as adhesions, bands, angulations, or anomalies, preventing the outflow of bile from the organ. There is convincing evidence that these infrequently discussed points in the foregoing paragraphs explain symptoms of many cases in the presence of an apparently normal gallbladder.

PHYSIOLOGIC FACTORS

Recent years have brought to light many new and important facts in the physiology of the gallbladder and its ducts. Ivy and others have done much to further this study but many things are yet to be discovered. Many of the greatest advances in the knowledge of gallbladder physiology have been produced since the introduction of the Graham-Cole test in 1924.

Paulson considered that three pathologic-physiologic processes follow a disturbed sphincter of Oddi: (1) increased activity of the gallbladder and ampulla with rapid emptying—the hyperkinetic type of evacuation, (2) contraction of the gallbladder against spasm of the sphincter resulting in bilary colic—hypertonic dyskinesia, and (3) atonic gallbladder with a spastic sphincter producing a heavy aching sensation. Kanuth, after a comparative analysis of one hundred cases each of cholecystitis with and without stones, believed that the great majority of unimproved patients in the stoneless group must be explained on the basis of physiologic

changes and altered function. Thornton, in quoting Rehfuss, stated that there is convincing evidence of the relationship between heart disease and gallbladder disease since 10 per cent of the cases giving symptoms suggestive of anginal disease were relieved by surgery of the biliary system.

Disturbances of physiology that may play a part in biliary disease do not necessarily affect the gallbladder alone. Schwartz and Herman found obesity in 52 per cent of gallbladder cases and in 56 per cent of heart cases, with 68 per cent of his obese patients with gallbladder disease showing heart disease. Willius and Fitzgerald reported an incidence of heart disease in 39 per cent of a series of 596 gallbladder cases, and of these 75 per cent were of the degenerative type with obesity. Bearse discussed the relationship of obesity and gallbladder disease in patients under thirty years of age and noted that only 19 per cent were overweight, 74.6 per cent average weight, and 6.3 per cent were noticeably thin. In respect to obesity as a disturbance of physiology in gallbladder disease, Wakely described the suspected patients as "fair, flabby, fat, fertile, flatulent, females of forty."

Twiss wrote that gastric acidity is disturbed in 75 per cent of patients with gallbladder disease and he concluded that achlorhydria is an important contributing factor to biliary infection. Brown, in his study of 346 cases, however, found only two with hypochlorhydria and four with achlorhydria.

DeCourcy found the blood iodine in cholecystitis, hepatitis and obstructive jaundice to be above the normal level of 3 to 6 micrograms per 100 cc. The average values in chronic cholecystitis in the presence of stone was 16.6 micrograms per 100 cc. This author concludes that iodine metabolism is a function of the stellate cells of Kupffer.

Boland, in making a comparative study of gallbladder disease in white and negro patients, concluded that physiological factors such as idleness and lack of exercise together with excessive eating and drinking

account for a ten times greater incidence in white than in colored persons.

The question of cholesterol metabolism is not settled. Some authorities claim that cholesterol is absorbed by the gallbladder mucosa. Others claim that it is not absorbed but mainly prepared for use by the body. Twiss and Barnard stated that a disturbance of cholesterol metabolism, although generally conceded to be a major contributing cause in the formation of stones, is as yet a little understood phenomenon. T. R. Brown, however, wrote that there is increasing evidence that the intake of lipoids by mouth plays little or no part in cholesterin metabolism. Twiss and others explained that an increased concentration of cholesterol in the presence of infection or stasis may account for the formation of stones. If this is the situation, it could hardly be said that the disturbance of cholesterol metabolism causes the stones, but actually the disturbance is the result of preexisting pathologic factors. This comment is supported by Doran and others in stating that the finding of crystals in the bile is not pathognomonic of stones but is evidence of pathology in the biliary tract. The statement can be found in the literature that hypercholesterolemia is usually associated with gallstones.

DISCUSSION

In a previous study of the noncalculous disease syndrome, the author showed that many patients having had poor results from cholecystectomy had their medical records extended to include many other diagnoses during periods of six months to seven or more years after operation. These diagnoses include myxedema, psychoneurosis, neurasthenia, achlorhydria, dyskinesia, pulmonary tuberculosis, arthritis, hydronephrosis with Dietl's crisis, migraine, pylorospasm, intercostal neuralgia, hypotension and angina pectoris. Graham (Roscoe R.), in discussing the failures of surgery in this class of gallbladder disease, noted three points: (1) irreparable damage from infection and scarring, (2) persistence

of gastric and pyloric spasm, and (3) failure to remove stones from the common duct.

Deaver and Bortz considered the most important differential lesion to be gastric or duodenal ulcer and carcinoma of the stomach. Kanuth stated that ulcer and spastic conditions of the gastrointestinal tract and diabetes mellitus may cause false positive reactions of the cholecystogram. Residual symptoms then, he noted, were due to errors in diagnosis, residual pathologic changes, physiological causes, duodenal diverticula, tubercular spondylitis and chronic gonorrheal peritonitis must be ruled out. Walters listed in addition that cholangeitis, pancreatitis, carcinoma of bile ducts, ampulla or pancreas, gastric crises and kidney lesions must be differentiated from the noncalculous cholecystitic syndome. The large number of differential lesions encountered in practice and by reading on the subject leaves one with only one thought, namely, that practically every diagnostic aid must be used in order to establish a working diagnosis if unnecessary surgery is to be avoided.

The points discussed in regard to etiologic factors cannot possibly be disregarded in the study of a patient with this dyspeptic syndrome.

SUMMARY

The etiology of chronic noncalculous cholecystitis is based on a multiplicity of related factors.

The three phases of the etiology are pathologic, mechanical and physiologic.

Differential diagnosis is perhaps one of the most important aspects of this syndrome.

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IN cholecystitis there is usually no jaundice, but all the signs of local and general infection—pain, tenderness, leucocytosis, and fever—are present.

THE USE OF STILBESTROL IN THE MENOPAUSE AND OTHER CONDITIONS*

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DODDS, Lawson and Noble, Goldberg and Robinson, MacGregor, and Winterton and Loeser have brought to the fore a drug, identified chemically as 4, 4-dihydroxy-alpha-beta-diethyl stilbene. This substance, called stilbestrol, is capable of replacing in every way the action of estrone or estradiol, despite the fact that the molecular structure is entirely different from that of natural estrone. The amount of 1 mg. of diethylstilbestrol is equivalent to 25,000 international units of estrone, according to observers.

Noble demonstrated that administration of aqueous solutions of stilbestrol orally was followed by reduction of growth of the animals, with a dosage of 2 to 3 mg. Inhibition of the gonadotropic hormone of the anterior pituitary gland, with resulting atrophy of the gonads, was observed when larger amounts of stilbestrol were given. In lactating rats as low a dose as 2 to 3 mg. per day appreciably reduced the growth of their litters. That the mammary glands were in a condition to yield more milk was shown by their increased secretion when treatment was discontinued. It was not found possible to inhibit lactation completely, even when stilbestrol was administered to the female rat before parturition.

Mellish, Baer, and Macias reported that stilbestrol and stilbestrol dipropionate were at least as effective as an equal weight of estrone in producing growth and development of the immature rabbit uterus and in sensitizing it to progesterone. Subcutaneous implants of 10 mg. of stilbestrol and stilbestrol dipropionate in animals inhibited body growth and growth of the gonads. Treatment with the stilbene derivatives increased the weight of the pituitary, but did not cause a significant change in the weight of the adrenals.

It has been shown by Zondek and Sulman that approximately 50 per cent of the stilbestrol given is excreted, and can be recovered from the urine and feces, in approximately equal amounts. In contrast to estrone, stilbestrol is only rendered inactive in the organism to a small extent, resembling, in this respect, the hormone esters. Stilbestrol remains deposited at the site of injection for a considerable time (depot formation) and from there it is slowly absorbed, similar to the hormone esters. In the excreta large amounts of the active substance are found. The fact that the organism is unable to inactivate considerable amounts of stilbestrol may explain its possible toxic activity.

Kellar used stilbestrol in a group of over twenty women. In six patients suffering from severe menopausal symptoms, he was able to control the symptoms fully. In three cases of senile vaginitis and two of leucoplakia vulvae, the patients benefited to a marked degree. Three cases of secondary

amenorrhea bleed after courses of stilbestrol, but biopsies revealed only a proliferative endometrium with numerous mitoses. Attempts at treatment of inertia type of labor and therapeutic abortion failed to reveal any conclusive results as to sensitization of the uterus or improvement of uterine contractions. Occasionally there was, however, a striking success. Inhibition of lactation was induced by administration of 3 mg. of stilbestrol daily for a few days. There were three cases of nausea in this series.

Shorr, Robinson and Papanicolaou treated forty-four patients with stilbestrol. In eight cases, full follicular vaginal smears were obtained, while in seventeen others advanced prefollicular smears were shown. However, there was failure of increasing doses of stilbestrol to bring about progressive changes in the smears. Bleeding after cessation of treatment occurred in several cases of menopause and amenorrhea. There was relief from symptoms of menopause in twenty-eight cases. Toxic manifestations occurred as follows: nausea in thirty-seven, vomiting in fourteen, abdominal distress in thirty-one, diarrhea in seven, lassitude in thirty-two, skin rashes in eight, psychotic reaction in one, vertigo in six, marked thirst in one and paresthesias in two. These toxic symptoms persisted in some instances as long as three weeks after cessation of the treatment. The concept of local irritation of the gastric and intestinal mucosa is contradicted by the large number of severe reactions encountered when the drug was given intramuscularly. Buxton and Engle reported improvement of symptoms in seventeen patients treated with stilbestrol. Nausea and vomiting occurred in four cases and bore no relationship to the amount of the drug used. One patient developed albuminuria and casts in the urine, whereas previously no such findings had been observed. Liver function tests were inconclusive. Winterton and MacGregor treated fifty-one patients with stilbestrol and obtained good results in treatment of menopause and amenorrhea, similar to those

obtainable with estrogens. There were six patients who suffered by-effects, mostly nausea, with only two cases of actual sickness. Inhibition of lactation occurred in three patients with doses of 5 mg. daily in whom the drug was used before lactation had set in, and was of little advantage once lactation had begun.

Karnaky used stilbestrol in over one hundred patients, with gonorrheal vaginitis, pruritus vulvae and senile vaginitis. He gave doses up to 1 mg. without any harmful symptoms, but obtained nausea and vomiting with 1 mg. or over, occasionally. He states that he gave 5 to 60 mg. at one injection without ill effects. Vaginal pH changed from 6 to 7.2 to pH of 4.0 with 5 to 7 mg. of the parenteral medication. The patients were greatly benefited. Equal effects were obtained by mouth, by injection and by suppository. The vaginal mucosa became adult in type. Functional uterine bleeding was improved or stopped in fourteen cases. There was an improvement in the character of the endometrium on biopsy, the endometrial glands were smaller in some cases and the cystic endometrium returned to the resting stage. Three cases of amenorrhea were made to bleed by giving 2 mg. twice a week for three weeks. One case of dysmenorrhea was relieved.

Geist and Salmon used stilbestrol in thirty-eight menopause cases. When given by injection, estrogen smear changes appeared after administration of 10 to 20 mg. Flushes, in particular, were relieved by total dosages of from 15 to 25 mg. Nausea and anorexia occurred in 20 per cent of the women. In twelve patients who had oral administration, ten developed toxic symptoms on doses of 1 to 5 mg. daily. Only eight patients were able to continue the drug more than a week. It is interesting to note that two of the cases which did not respond clinically showed vaginal smears indicating an estrogen effect. Resnik's work with stilbestrol yielded good clinical results in most cases with about 25 per cent toxic by-effects noted.

Biship, Boycoll and Zuckerman noted nausea and vomiting in three of forty-six patients. Varangot found severe gastrointestinal reactions in eight of eighteen women. Ehrhardt, Kramson and Schafer also reported a large number of unpleasant side effects which, however, they incline to attribute to overdosage of stilbestrol. R. Kurzrok, Wilson, and Perloff reported a number of toxic symptoms resulting from the use of stilbestrol.

Lack of agreement is seen in the reports of toxicity studies in animals. They uniformly confirm the estrogenic activity of the compound and reveal an extraordinary similarity in action to the natural estrogens. But in contrast to the early indications of its harmlessness, Loeser noted in rats, decreased appetite, epistaxis, vaginal and intestinal hemorrhages, fatty degeneration with subsequent necrosis of the liver, enlargement of the adrenals with arterial hyperemia and bleeding and enlargement of the spleen with hemorrhagic reaction in the islands. According to Krietmair and Siechmann the administration of from 0.5 to 1 mg. per Gm. to mice resulted in death in from 10 to 16 days. In rats 1.5 to 5 mg. per Gm. resulted in paralysis and death in an hour. Tislowitz observed a disturbance of the hyelogenic system, and granulocytopenia and anemia in dogs receiving 5 mg. by injection for from twenty-five to fifty days. Morrell, on the other hand, has failed to observe any pathologic changes in the tissues of rats, rabbits and monkeys.

A series of 122 women treated by the administration of diethylstilbestrol and diethylstilbestrol dipropionate is herein reported. Since these two synthetically prepared compounds have shown much the same effects and benefits, as well as by-effects, and the effect on the vagina appears to be almost identical, we do not differentiate in the results obtained.

The indications for treatment were as follows: menopause, 112 cases; arthralgia (menopausal), eight cases; migraine, two cases; and premenstrual tension, four cases.

Administration of stilbestrol was by intramuscular injection in doses of 1 to 5 mg. twice weekly or parenterally in amounts of 2 to 3 mg. daily. Similar results were obtained with the two modes of therapy.

Vaginal pH determinations and vaginal smears were done routinely at weekly intervals during and after cessation of stilbestrol treatment. Cases previously treated with estrogens revealed a vaginal pH of 4 to 5 and a vaginal smear of plus 3 to 4, according to the technic of Papanicolaou and Shorr. Untreated patients usually showed a vaginal smear of plus 1 to 2, and an acidity of pH 6 to 7.

After administration of 1 mg. of stilbestrol, for a period of two to three weeks, the vaginal acidity ranged between pH 5 to 6 generally with a plus 2 to 3 vaginal smear. After administration of 2 to 5 mg. of stilbestrol for a period of two to three weeks, the vaginal acidity was between pH 4 to 5 with a plus 3 to 4 smear. A number of cases showed considerable inconsistency between the vaginal smear and pH determination, such as a full estrogenic smear with pH of 6 to 8. Five weeks after cessation of stilbestrol medication, the general picture was that of reversion to the untreated state. There were several exceptions, in which full follicular smears and pH of 4 to 5 were found. A number of these patients complained of moderate menopausal symptoms, even though full estrogenic vaginal effect was noted, a finding in accord with other reports.

Biopsies of the endometrium in cases of bleeding varied from hyperplasia during menorrhagia to insufficient material in a postradium menorrhagia, to a secretory endometrium in a thirty-seven year old woman with premenstrual tension and menopausal complaints.

Successful results were obtained in seventy-eight cases or 64 per cent, with dosage of 2 to 5 mg. administered by injection, biweekly, or 2 to 3 mg. given parenterally daily. A few patients were benefited by doses of 1 mg. daily. The two cases of

premenstrual migraine were aided. Five of the cases of arthralgia were improved. Four women with premenstrual tension were helped in various degree. There were twenty-eight cases, or 35 per cent, who were intolerant to stilbestrol and in whom medication had to be discontinued almost immediately. Total dosage in some instances was 200 mg. given over a period of two to three months.

Reactions to stilbestrol therapy occurred as follows:

	No. of Cases
Locate reaction to injection or generalized rash with pruritus	10
Nausea	37
Vomiting	20
Epigastric distress	10
Diarrhea	-
Weakness or faintness	4
Aching joints	1

Among the toxic by-effects, nausea usually lasted for two to three days and diarrhea for the same length of time. In no instance was there any tenderness over the liver or jaundice. Mastalgia did not occur. There was no bleeding in postsurgical menopause cases. Increased vaginal secretion occurred in several patients. Moderate bleeding occurred in thirteen cases, in women still menstruating with menopausal complaints during treatment with stilbestrol. Bleeding occurred in one patient six years postmenopause lasting fourteen days.

The effect of stilbestrol upon lactation will be reported at a later date.

SUMMARY

1. Stilbestrol was used in a series of 122 women mainly with menopausal complaints.

2. Vaginal smears generally showed a good estrogenic effect.

3. Vaginal pH determinations frequently did not coincide with the cytologic changes.

4. Successful results were obtained in 64 per cent of cases.

5. Toxic manifestations occurred in a considerable number of patients, the most frequent being nausea, which took place in thirty-seven cases, or 30 per cent.

6. Toxic manifestations did not seem to depend on total dosage.

7. Stilbestrol should be used *only* on direction of a physician and the patient followed carefully.

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DIVERTICULA OF THE STOMACH

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GASTROSCOPY is an increasingly valuable method of diagnosis. Numerous lesions involving the stomach are being visualized and accurately described by able gastroscopists. Gastric diverticulum is one of the less frequently seen lesions in any endoscopic clinic. Because of this, we should like to present certain features of these lesions and give the clinical records of two patients with this condition.

The differentiation between gastric diverticula and diverticulum-like formations occurring secondary to perforating peptic ulcers or carcinoma is at times difficult but extremely important.

INCIDENCE OF DIVERTICULA OF THE STOMACH

Martin could find no record of diverticula of the stomach in the archives of the history department of Johns Hopkins Hospital. He found five cases reported by the pathologic department. Shiflett found an incidence of 0.65 per cent during roentgenologic study of stomachs in 786 patients. Cheney and Newell found two gastric diverticula in 11,828 roentgenologic examinations of the stomach. Rivers, Stevens and Kirklin reported that four gastric diverticula were found in 3,662 routine necropsies, and ten diverticula were removed in 11,234 exploratory operations of the stomach at the Mayo Clinic.

CLASSIFICATION OF GASTRIC DIVERTICULA

Diverticula of the stomach have been classified as follows: (1) true (congenital) diverticula; (2) false (acquired) diverticula, (a) pulsion type and (b) traction type.

The congenital type of diverticula is believed to be the result of malformations or interrupted development during the embryonic period. All layers of the stomach wall are intact.

The false or acquired type has one or more layers of the stomach wall absent. It is believed that some abnormal force is responsible for the pouching. This group has been divided into the pulsion and the traction types. In the former group, the implication is that the force which caused the diverticulum has come from within the stomach. Many theoretical causes have been given for increasing intragastric pressure with subsequent herniation of part of the gastric wall and formation of a diverticulum. Labor, pyloric obstruction, vomiting, chronic cough, foreign bodies in the stomach and constipation with straining at stool are some of the possible etiologic factors mentioned in the literature.

Traction diverticula result from contraction of perigastric adhesions. Any organ which has been the site of an inflammatory process or of a previous surgical procedure may be responsible for perigastric adhesions. As these adhesions contract, they may cause formation of a diverticulum in the stomach. The gallbladder, pancreas or spleen may be the primary organ involved. Adhesions between the anterior abdominal wall and the stomach may also be responsible for this type of diverticulum. Most diverticula occur near the cardia on the posterior wall toward the lesser curvature, but they may occur at any site. Pancreatic tissue and benign growths, such as adenomas and myomas, have been described in gastric diverticula.

Formation of an acquired false diverticulum in the stomach may be the result of a perforating ulcer or a neoplasm.

GASTROSCOPIC FINDINGS

Gastroscopic examination should aid in differentiating these last named lesions and

gastric diverticula. The orifice of a diverticulum has the appearance of a circular hole. The margins are rounded and sharply

a dull sense of discomfort or a sense of pressure in the epigastrium to a definite epigastric pain. This pain may be periodic,
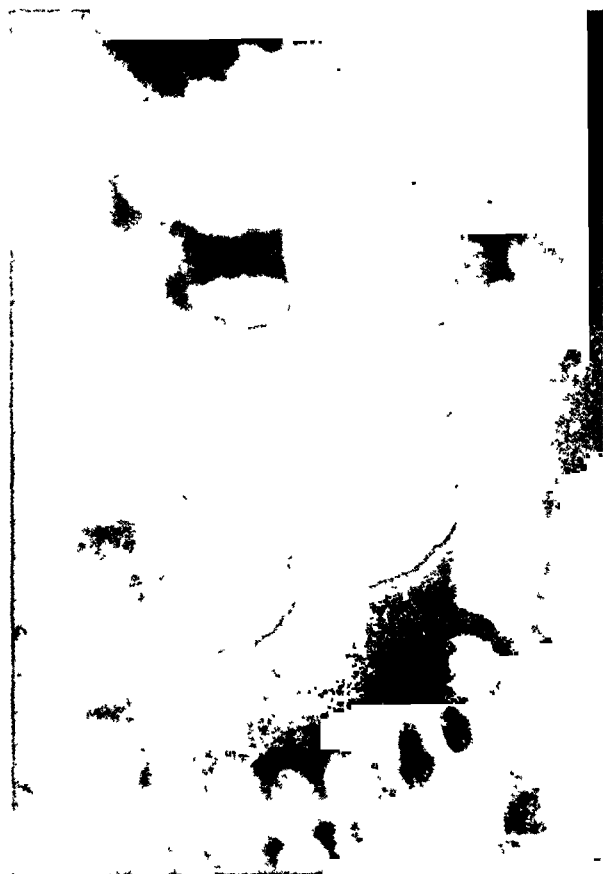
FIG. 1. Diverticulum at the cardia before operation.

defined. The surrounding mucosa may be entirely normal. There is no sign of infiltration at any point. A penetrating gastric ulcer usually has a base which is covered with a gray or white exudate, or is more rarely covered with blood. The surrounding mucous membrane is quite apt to show evidence of an associated inflammatory reaction. A penetrating carcinoma shows signs of ulceration in the base of the sac, and the surrounding margins are irregular and infiltrated.

SYMPTOMS

It is thought that most gastric diverticula do not give symptoms. In certain cases, however, there are definite symptoms present which disappear after excision of the diverticulum. These may range from

burning or gnawing in character, and may or may not be relieved by food. At times, the pain may radiate to the lower retrosternal region. Massive hematemesis has been described.

CASE REPORTS

CASE I. The patient was a man, thirty-seven years of age. For the last twelve years he had experienced "pressure pains" in the upper part of the abdomen. He stated that he would usually awaken about seven A.M. with a "bloated sensation" in the upper half of the abdomen. He would experience an urgent desire to pass flatus. Belching and passage of flatus would relieve the distress. There would be considerable discomfort again about four or five hours after eating. The trouble seemed to be definitely worse in the decubitus position, and for the past two years he had experienced

daily nocturnal distress in the upper part of the abdomen. Almost every night he would take soda water by mouth and induce vomiting, which would give relief. The vomitus at times would contain particles of food eaten twelve hours previously. His father-in-law, a physician, had taken a roentgenogram of his stomach and found a gastric diverticulum.

He was referred to the Mayo Clinic. Roentgenologic study revealed a diverticulum in the upper part of the stomach near the cardia. (Fig. 1.) Gastroscopic examination was performed and it was possible to obtain an excellent view of the orifice of the diverticulum which was located high on the posterior wall. The opening appeared as a sharply circumscribed hole and was about the diameter of a small finger. There was a mild degree of gastritis in the lower quadrant of the orifice of the diverticulum, but there was no evidence of infiltration or ulceration. (Fig. 2.)

The diverticulum was explored surgically and was found to arise from the posterior wall of the cardiac end of the stomach. The orifice was 2.5 cm. from the lower end of the esophagus. The diverticulum was 3.5 to 4 cm. in diameter, and its orifice was about 1 cm. in diameter. It was excised, and the resulting defect in the gastric wall was sutured. The patient made a very good recovery. Subsequent information after his return home states that he is getting along very well. He is able to sleep through the night without any discomfort. His appetite is good and he has gained 10 pounds (4.5 kg.).

CASE II. This patient was a woman, thirty-three years old. She had been under observation and treatment at the clinic for six years. At the time of her first admission, in 1932, she told of being troubled with flatulence, bloating and rumbling in the abdomen. At times, she would have frequent soft stools, passing between two and four stools in twenty-four hours. Roentgenologic studies of the stomach revealed a diverticulum of the cardiac end of the stomach. Roentgenologic studies of the gall-bladder, colon and small bowel gave negative results. Diagnoses of irritable bowel and diverticulum of the stomach were made. It was believed that her symptoms were coming from her irritable bowel, and she was given a dietary regimen. It was not thought advisable to explore the gastric diverticulum at that time.

She returned to the clinic in July, 1938, at which time she stated that during the past

year she had experienced a periodic, gnawing, epigastric pain. The last attack of pain had occurred four months before coming to the

FIG. 2. Gastroscopic appearance of diverticulum.

clinic. The pain would come about two hours after meals and was occasionally associated with nausea and vomiting. On one occasion she had vomited bloody material. The pain would persist until she would eat, or drink a glass of milk. During an attack, pain would be present every day and would occasionally occur at night. Gastroscopy was performed elsewhere during her last attack of distress, and two or three superficial erosions were seen in the region of the diverticulum. Alakalis and tincture of belladonna were prescribed.

On her last admission at the clinic the roentgenologic examination again showed the diverticulum at the cardiac end of the stomach. (Fig. 3A.) Gastroscopic examination was performed and the orifice of the diverticulum was seen just below the cardia. There was no evidence of inflammation of the gastric mucous membrane in the neighborhood of the diverticulum. The orifice was seen to open and close in a rhythmic fashion. It was believed that the symptoms referable to the epigastrium might be coming from the gastric diverticulum. Exploration of the diverticulum was advised.

The stomach was explored and a false diverticulum was found along the lesser curvature just below the cardio-esophageal orifice. The diverticulum measured about 3.5 cm. in diameter. The anterior wall of the stomach was

opened and the mouth of the diverticulum was found to be wide open. It was decided that the sac could not be excised without considerable

secondary to perforating peptic ulcers and ulcerating carcinomas of the stomach.

A case of true diverticulum and a case of

FIG. 3A. Diverticulum at the cardia before operation; B, roentgenogram of stomach after operation.

risk because of its high location. Because of this, it seemed advisable to invert the diverticulum. The patient's convalescence was uneventful. Roentgenologic examination after operation showed no evidence of the diverticulum. (Fig. 3B.)

A report by letter one year after operation states that she is "generally speaking, well, and losing no time from work." She occasionally experiences distress from her irritable bowel condition.

false diverticulum of the stomach are presented. Both patients had symptoms which were thought to be due to the diverticula. These symptoms disappeared after surgical procedures which eliminated the diverticula.

SUMMARY

Gastroscopic examination can aid in differentiating gastric diverticula from diverticulum-like formations which develop

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BURSA AND GANGLION

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SINCE 1780, when Monro published "A description of all the bursae mucosae of the human body," bursae have been the subject of considerable study and speculative comment among medical writers. Even down to the present time the subject has remained of interest because of the recognized relationship between the joints proper and the bursae. It is now generally conceded that, from anatomic, physiologic and pathologic viewpoints, there exists more than an academic relationship between them. Some authors go so far as to consider the joints proper as merely highly differentiated bursae. According to Piersol's broad definition, bursae are sacs filled with fluid which are found wherever friction may occur between various structures. In addition to the constant and acquired bursae, this definition would apply to the joints and also to the pleural, peritoneal and pericardial cavities. For practical purposes, this definition is perhaps too wide in its scope and we must necessarily restrict this portion of our report to include only the bursae. We must admit, however, that very little play on the imagination is required in order to place the joints in the same general category with the bursae.

Along these same lines, the subject of the tendon-ganglion also must be considered. In this, we are treading on firmer ground, and therefore can feel justified in considering bursae and ganglions together in the same discourse. According to H. T. Jones, "bursal hygromas, including the accidental or occupational bursae, such as those on clubfeet and miners elbows, together with carpal ganglions and the synovial lesions of the fingers, are variations of the same fundamental process." For the sake of

simplicity, however, we shall consider them under separate headings. A correlation between the two will be made when pertinent.

BURSA

Henle,[25] in 1838, considered the linings of the joints and bursae as epithelium. Later, Heuter, Hagen-Torn, Hammar, and others have declared the synovial cells to be of connective tissue origin, as indicated by Virchow. This is the viewpoint generally held by many today, although Kling,[32,33] Meyeda, and King, among recent authors, look on the synovial cells as truly secretory in nature, and therefore either epithelial or very highly differentiated connective tissue closely akin to epithelial elements. Kling, in expressing his opinion as to their secretory nature, based it on a study of the synovial cells which he has made by means of an original staining technic. He claimed to have demonstrated mucin vacuoles in the cytoplasm of these cells, just as one may observe them in the secretory epithelial cells of the intestinal tract. By means of two other methods of staining (Mayers and Galantha), we[4] have been unable so far to demonstrate such secretory granules either in the normal or in the pathologic synovial membranes. As yet, we have not employed Kling's method of staining.

Döměny, in 1897, reported his work on the embryology of the deep and superficial bursae in the human embryo. He concluded that the deep bursae developed before the superficial ones, but that the process of development was essentially the same in each instance. The superficial bursae often did not reach their anatomic maturity until long after birth and after movement had been initiated.

According to Jones, the development of the deep bursae is very closely related to development of the joints. Like Piersol, he considered the joints as highly differentiated and specialized bursae.

In 1890, Schuchardt described a bursal hygroma which he had removed from the external malleolus of a tailor. He described the phenomenon of cystic bursal formation as a "process of inflammatory production of new tissue" with hyperplasia of connective tissue and later liquefaction. He was able to demonstrate mitotic figures in the proliferating cells.

Langemark, in 1903, held that this so-called proliferation of connective tissue did not take place before liquefaction in bursal hygromas. He believed that the liquefied material was a purely degenerative substance, a viewpoint which fits well with the conception held by many that the mucinous substances present in the joint and bursal fluids are the products of degeneration rather than true secretion. Langemark further thought that bursae are often likely to become enlarged and filled with fluid as a result of repeated trauma. The enlargement was regarded by him as simply an exaggeration of the process which originated the bursae.

Codman, in 1906, first described subacromial or subdeltoid bursitis. At that time he recommended surgical removal of the bursa and whatever deposits might have formed in or about it.

It was Churchman, in 1909, who called attention to specific infections in bursal swellings, particularly syphilis. He reviewed twenty-eight cases of bursitis which he considered the result of syphilis. He mentioned the rapid response to specific therapy in these cases. In respect to specific diseases of the bursae, Earl, in 1918, pointed out that gonorrhea, tuberculosis, syphilis and metabolic disturbances such as gout, may affect the bursae. He also mentioned that bursitis may follow pyemia, typhus, scarlet fever and variola.

Henderson in discussing Earl's paper recalled that in prepatellar bursitis repeated bacteriologic studies in his experience had not shown the presence of organisms and that he was inclined to believe that in the majority of cases of bursitis, particularly prepatellar bursitis, mechanical irritation was the principal etiologic factor.

Perhaps one of the most enlightening works on the subject of the bursae within recent years is that of H. T. Jones. In 1930, in addition to reporting fifty-five cases of cystic bursal hygromas from clinical and pathologic standpoints, he made a rather comprehensive review of the literature on the general subject of bursae. He touched particularly on the historic conceptions of their development and the anatomic and embryologic backgrounds for such conceptions. We have drawn freely from his references as a background for this study.

It has been known for some time, as indicated by Earl, in 1918, that tuberculosis may infect the bursae. Among recent reports, those of Cicala, Meyerding and Mroz, and Deacon are of interest. Meyerding and Mroz, in 1933, emphasized the importance of tubercular lesions in the femoral trochanters and associated bursae, while Cicala, two years later, reported four cases of this disease involving the bursae in this region. Deacon, in 1935, reported a case of tuberculosis involving the subdeltoid bursa bilaterally.

Gonorrhea may produce a bursitis secondary to the primary inflammation in the genital tract. Strominger, in 1936, has given the latest report of this condition, indicating the serous nature of the fluid usually found in this type of bursitis.

Among other specific infections fungi have been known to invade the bursae, but only rarely.

Neoplasms of the bursae, if one does not include the cystic hygromas which, from all prevailing evidence, do not appear to be true neoplasms, are reported as being extremely rare. Geschickter and Lewis, in 1934, were able to collect only thirty reported cases from the literature and from the records of the Johns Hopkins Hospi-

tal. Among the most common tumors were benign and malignant chondromatous growths and fibrosarcomas. They found the prepatellar bursa the one most often involved. It was shown that osteochondromas were likely to recur and become malignant. Zwahlen has reported the development of synoviomas from the bursae as well as from the tendon sheaths. Xanthomas also have been noted to arise from the bursae. It is conceivable that the bursae may give rise to any type of neoplasm which might develop from connective tissue. In respect to the opinion held by some that the synovial cells are epithelial in nature, it is to be noted that true epithelial bursal tumors are conspicuous by their absence in the literature. The synoviomas, according to McDonald, appear to resemble the endotheliomas more than any other tumor, an observation which in part substantiates the opinion that all cellular elements found in bursae originate from connective tissue.

Anatomic Classification. Piersol has classified all bursae into two main anatomic classes: the deep and the superficial bursae. He refers to the deep bursae as "synovial" and to the superficial as "mucous," indicating that there is, in his opinion, a difference in the lining membranes of the two types. It is our contention that there is no essential difference between the lining cells of the deep bursae and those of the superficial ones. The subsynovial tissue may be thicker in the deeper ones, but the structure throughout and the derivation are essentially the same, that is, all bursae arise from the mesoderm. Therefore, we believe that the separate terms, "synovial" and "mucous," are obsolete and that the term, "synovial," should apply to all bursal lining membranes, including those of ganglions.

Of the deep bursae (Piersol's "synovial" group), those that have a connection with a joint may be normally present, or may be a congenital addition; those that do not have a connection with a joint may be normally present, a congenital addition or of the adventitious or acquired type.

Of the superficial bursae (Piersol's "mucous" group), those that have a connection with a joint (socalled synovial cysts) may be of the congenital or acquired type; those that do not have a connection with a joint may be normally present, a congenital addition or of the adventitious or acquired type. The types of bursae that are of great clinical importance are the deep bursae that are normally present, and the superficial bursae that are normally present or are of the adventitious or acquired type.

It is not our claim that such origins always may be demonstrated or that the classification holds strictly true to form in all instances. It seems that, at some time during the development of certain bursae which normally do not connect with joints, there might have been such a connection. Cords of fibrous tissue which occasionally are seen connecting a synovial cyst or a ganglion with the capsule of a joint are, perhaps, remnants of such connections.

Etiologic Classification. Meyerding[40,41] has said that "Bursitis may be classified as acute or chronic, traumatic or infectious, and syphilitic, gouty or malignant." He has also mentioned tuberculosis, gonorrhea and rheumatism as etiologic factors. He has further observed that "when bursae become distended, they are called bursal cysts or hygromas." Shands included more or less the same factors and agents in his discussion on the subject. He has emphasized that trauma is by far the most important, although he acknowledged that even as rare a condition as a toxic bursitis from lead poisoning had been known to exist. Shands did not refer to cystic bursal hygromas or neoplasms.

For our own purposes of clarification, we have outlined a detailed etiologic classification of bursitis and hygromas, as may be seen in Table I. We have based this on those descriptions which have been mentioned and on whatever information we could gather on the subject from the current literature.

In regard to the acute types, the outline is self explanatory. Under nonspecific infec-

tious bursitis, we have included rheumatic as well as toxic and unknown types, because prevailing knowledge does not allow us more specific terms. It is known that in certain types of arthritis and rheumatoid conditions one may observe a bursitis which has all the characteristics of an acute infectious process but from which a specific agent of disease cannot be cultivated. One also may observe the same condition after certain generalized infectious diseases.

TABLE I

ETIOLOGIC CLASSIFICATION OF BURSITIS AND HYGROMAS

i. Acute
  A. Infectious
    1. Specific
      a. Pyogenic (staphylococcic, strepto-
      coccic, pneumococcic)
        1. Suppurative
        2. Nonsuppurative
      b. Gonococcal
    2. Nonspecific
      a. Rheumatic
      b. Unknown
  B. Traumatic
  C. Traumatic and infectious
ii. Chronic
  A. Infectious
    1. Specific
      a. Pyogenic
      b. Gonococcal
      c. Tubercular
      d. Syphilitic
      e. Fungous infections
      f. Others
    2. Nonspecific
  B. Traumatic
  C. Traumatic and infectious
  D. Metabolic
    1. Gouty
    2. Calcinosis circumscripta
  E. Cystic manifestations
    1. Cystic bursal hygromas
    2. Ganglia
  F. Neoplastic
  G. Congenital anomalies and hereditary tendencies
  H. Toxic reactions to metal and other specific poisonings

In the chronic type of bursitis, by far the most common is the traumatic. In both the acute and the chronic traumatic types there may occur superimposed infection. The term, "traumatic," is meant to include any type of trauma whether it is acute or chronic irritation.

We recognize readily the weak points in this classification. For instance, calcinosis circumscripta has been included under the metabolic type of bursitis even though we are not sure that it is a metabolic disease. It is known to have hereditary tendencies and it may affect siblings, as illustrated in a case to be reported by one of us.[18] With reservations, we have placed cystic bursal hygromas and the ganglia in the same class. Our reasons for so doing will be found in the section on "Ganglion."

It is admitted that it would be a difficult feat to classify all bursal swellings in so detailed a fashion as we have indicated. In our own cases we have found this true. However, there is no reason why such cannot be attempted, if a reasonable amount of judgment is exercised. Perhaps future efforts toward more painstaking diagnosis in these cases will prove helpful in amending or correcting our present attempt to classify them.

Clinical Material. In this report we are including thirty-seven cases of bursitis which were encountered over a period of six years, from January, 1928 to December, 1934, at the Mayo Clinic. A summary of the pathologic studies made in these cases had been previously reported.[16] In these thirty-seven cases a total of forty-one bursae were removed surgically. This series of cases does not include the acute suppurative types nor does it include those cases of bursitis in which treatment was conservative. In addition, the bursae which have been removed from bunions and the so-called bursal cystic hygromas were not included, with the exception that in the latter case there might have been borderline pathologic types included under the chronic traumatic cases in which distinctions were made with difficulty.

There were twenty-six males and eleven females in this series; the average age was forty-five years. The youngest patient was fifteen years of age, the oldest, sixty-six. The average duration of symptoms was two and one-half years, the longest, fifteen years and the shortest, twenty-four hours. The anatomic distribution of the bursae was as follows: elbow, five; olecranon,

seventeen; wrist, one; finger, one; prepatellar, twelve; popliteal, one; head of tibia, one; shoulder, one; subacromial, one, and foot, one.

Data that pertain to the types of surgical procedures and results are given in Table II. The different types of disease and the

TABLE II
SURGICAL PROCEDURES AND RESULTS

Type of Procedure	Good Result	Re-currence	Results Un-known	Not Ex-cised	Miscel-laneous
Complete excision of sac..........	22	8	8		
Partial excision of sac.............	..	..	1	..	1*
Biopsy...........	..	..	..	1	
Total..........	22	8	9	1	1

* Persistence of disability without recurrence of swelling.

results of treatment in each type are indicated in Table III.

Comment. It will be noted that in only one case of subacromial or subdeltoid bursitis was operation necessary during the

TABLE III
RESULTS OF TREATMENT IN RESPECT TO DISEASE PRESENT

Types of Disease	Num-ber	Good Result	Re-currence	Un-known	Miscel-laneous
Chronic traumatic	18	12	2	3	1*
Acute traumatic.	4	3	1		
Chronic infections					
Rheumatic....	1	1			
Others........	5	2	3		
Tuberculosis.....	3	1	2		
Gouty..........	2	..	..	2	
Traumatic and infectious.....	2?	2			
Questionable.....	5	..	..	4	1—biopsy
Xanthoma.......	1	1			
Total.........	41	22	8	9	2

* Persistence of disability without recurrence of swelling.

period of time mentioned. When Codman originally described the condition, he rec-

ommended removal as the indicated treatment in the chronic cases associated with calcification. We have observed that, if the proper conservative regimen is followed in these cases of the chronic type, there usually will be a gradual improvement in the symptoms, and often the deposits of calcium in or about the bursa will be absorbed in time. Diathermic induction has proved useful in the temporary relief of pain. In the acute cases with severe pain, one may resort to the injection of procaine, continuous traction and sometimes, roentgen therapy. With the exception of the subdeltoid bursa, surgical excision is undoubtedly the treatment of choice for chronic and persistent bursitis associated with swelling and symptomatic discomfort and disability. This is especially so in those cases in which the affection is local and unilateral and in which the bursa is readily accessible for operation.

In the forty-one cases in which bursae were removed there were only eight known recurrences. Every attempt should be made to excise the sac completely at the first operation. In the two cases in which it was known that only partial excision was performed, the results were disappointing in each instance. In the eight known cases of recurrence, there were undoubtedly some in which the sac was incompletely removed, even though the surgeon at the time of the operation believed that complete excision had been performed.

The most common types of acute and chronic bursitis were those caused by trauma. There were two other cases in which a history of trauma was obtained and additional signs and symptoms of a superimposed infectious process were present. There were no records to indicate that specific organisms had been recovered from these bursae.

We have included six cases under the chronic nonspecific infectious types. Two cases of multiple bursal swellings were included in this class, and the clinical indications were that they were the result of some infectious process. In the six cases

thus classified, rheumatic complaints were predominant.

Tuberculosis was the only specific infectious disease represented in the entire series. In two cases the bursae of the olecranon were involved and in one, those of the knee. In the latter case an arthrodesis was performed. A good result was obtained from the excision of one bursa of the olecranon whereas draining sinuses from the other bursa were present at the time of the last report. In all three cases there was no evidence of active pulmonary tuberculosis, and this is not unusual. In the case which Deacon reported with bilateral involvement of the subdeltoid bursa, there was no active disease of the lungs. In the majority of other cases of bursal tuberculosis reviewed in the literature, the same held true. Tuberculosis usually affects the large bursae around the large joints, such as the knee, hip and elbow. However, one of us (R. K. G.) recently operated upon a patient and found a tuberculous bursa at the base of the great toe without signs or symptoms of the disease elsewhere in the body. To our knowledge this is the only case which has been recorded in which tuberculosis was found to have infected a bursa about the toes.

We have included a case of xanthoma in a bursa. We did this assuming that a xanthoma is probably not a true neoplasm but rather a special reaction to inflammation often associated with a disturbance in the metabolism of cholesterol. At least this is the opinion held by Galloway and Broders and Ghormley, who have collected and studied the largest series of cases of xanthoma yet recorded. Geschickter and Lewis previously have observed the occurrence of bursal xanthomas. One might be justified in classifying a bursal xanthoma with gout as metabolic bursitis.

Although we have not included any cases of acute suppurative bursitis in this series, it might be well to mention their treatment. Usually they should be handled as any other acute suppurative infection, with rest, local heat and supportive treatment.

Incision and drainage should be carried out as indicated, and special caution should be exercised that only the infected bursa, and not the adjacent joint, be drained. Meyerding[40,41] recalled a case of acute suppurative prepatellar bursitis in which the surgeon, unaware that the infection was localized in the bursa only, incised the knee joint proper, resulting in the expected pyarthrosis and subsequent ankylosis.

In infections resulting from streptococci, pneumococci, gonococci and sometimes staphylococci, some form of sulfanilamide should be administered if not contraindicated. Recently we have observed a case of pneumococcal bursitis of the shoulder following pneumonia in which a favorable response to drainage and oral administration of sulfapyridine occurred.

In the cases of acute traumatic bursitis, in which intense swelling is present, single or repeated aspirations may be resorted to in an effort to relieve the tension. Aspiration also may be employed for the acute infectious types of bursitis, for purposes of diagnosis and treatment in those cases in which the fluid is serous rather than purulent.

GANGLION

Carp and Stout have defined a ganglion as "a cystic swelling usually occurring in close proximity to joints and tendon sheaths and containing a thick mucinous fluid." Because of their proximity to tendon sheaths, ganglions are referred to often as tendon ganglions. The close relationship between cystic bursal hygromas and ganglions already has been alluded to. It is generally conceded that the lining of the bursae, joints and the ganglions is essentially the same type of tissue, although in the case of the bursae and joints, the synovial cells are commonly of a more highly differentiated character. Despite these similarities, there remains at least one important distinction which makes it difficult to consider the ganglion as a true type of bursa, at least, without some reservation. The bursa usually is found to have some

definite function either as a protector of a bony prominence or as a condenser of friction between gliding structures, even the pathologic and adventitious types of bursae while, the ganglion seems to have been donated to us by nature as an effect without a known cause. It is perhaps for that reason that so many writers have considered the ganglion a type of neoplasm. Then, in addition, with the exception of tuberculosis and nonspecific inflammation, ganglions are not, as a rule, so frequently victims of disease as are bursae. The explanation which has been offered for this is that the ganglions are, in themselves, a type of inflammatory reaction and are not to be considered as structures normally susceptible to the various diseases.

In reviewing the literature, one is impressed with the divergences of opinion in regard to the origin of the ganglion. Despite this inconclusive status, and perhaps for that very reason, the hypotheses regarding pathogenesis naturally claim our interest.

Eller, in 1746, advanced the hypothesis that ganglions resulted from rupture of the tendon sheaths. Later Vogt suggested their origin from the joints and bursae, as well as from the tendon sheaths.

Gosselin, in 1852, believed ganglions to be retention cysts arising in crypts of the synovial membranes. Virchow thought that ganglions developed from connective tissue clefts.

Henle,[24] in 1847, was perhaps the first writer to refer to ganglions as neoplasms. Meckel, in 1856, Hoeftman, in 1876, and Floderus, in 1915, advocated this same viewpoint. "Mucinous tumors," "serous cysts," "synovial dermoids" and "arthromas" are some of the neoplastic terms which have been affixed to ganglions.

Both Billroth and Volkmann, in 1882, considered the possibility of ganglions arising as herniations of tendon sheaths or of joint capsules.

The most generally accepted concept as to the origin of ganglions is the one originally proposed by Ledderhose, in 1893. He believed them to be degenerative cysts resulting from a cystic degeneration of the connective tissue around, but not inside, the joints. Among authors who have adhered to this concept are Thorn, Payr, Franz, Borchardt, Hofmann, Ritschl, Clarke, Thomson and Carp and Stout. Carp and Stout stated, in 1928, that ganglions were the result of a mucinous degeneration of the connective tissue, in which embryonic cysts originally were present.

Rees Jensen, in 1937, held that ganglions developed from embryologic rests in the periarticular connective tissue, basing his observations on the previous work of Harrison. Harrison, in studying the embryologic origin of derivatives of connective tissue, described the formation of synovial membranes, tendons and tendon sheaths from neophytic fibrils which had been elaborated by the gelatinous ground substance of the mesothelium. Jensen held that arrests in this development left potential pockets from which ganglions often developed.

It has been difficult, in the opinion of most authorities, to ascertain just how important a rôle trauma plays as an etiologic factor. Kuettner found a definite history of trauma in 20 per cent of his cases, but this certainly is not an amazing percentage when one considers how often the hands and wrists are subjected to trauma without the occurrence of ganglions.

Along with differences of opinion as to the genesis of the ganglion, we also have noted certain disagreements as to the best method of treatment. The oldest method consisted simply in bursting the ganglion by means of a book or a heavy object, dealing the swelling a sudden, swift blow. Then, of course, since the advent of aseptic surgical technic, surgical excision has been offered and frequently employed. Among conservative methods of treatment, aspiration with injection of sclerosing solutions, such as iodine or carbolic acid, into the sac frequently has been used. In respect to an ultraconservative attitude in the treatment of this condition, it is interesting to note that Carp and Stout, in their follow-up studies on twelve cases in which no treat-

ment whatsoever had been received found that seven, or 58 per cent, of the ganglions disappeared spontaneously.

Some surgeons have used a continuous pressure bandage over the area of the ganglion as a sole means of treatment, especially in those cases in which the patients have refused to have more radical procedures performed. The pressure bandage also has been used profitably as an adjunct to other forms of therapy. Neumüller and Orator in reporting 702 cases of ganglion, indicated that in ten cases in which a pressure bandage was used without other measures, the ganglion had disappeared and to their knowledge had not recurred. In the analysis of their results from all forms of therapy, they found that of fifty-two ganglions treated by bursting, twenty-three recurred. Of thirty-one cases in which the ganglion was surgically excised, in only one was there recurrence.

Kuettner in reporting the late results of treatment in 170 cases, recorded the following incidence of recurrences after the various types of treatment as outlined: puncture and injection, 57 per cent; breaking or bursting, 50 per cent; subcutaneous incision, 36 per cent and excision, 30 per cent.

Carp and Stout maintained that the method of injection and aspiration was the treatment of choice. We are outlining the analysis of their results in detail in order to evaluate properly their recommendation. (Table IV.)

Of 255 cases, Carp and Stout recorded follow-up studies on seventy and it is on these, or less than a third of their total cases, that they admittedly have based their conclusions as to the best therapeutic procedure. When it is considered that the authors have allowed the results of treatment in only eight cases out of this number (only eight patients were treated by aspiration and injection) to influence their preference in the treatment of the majority of all cases, their conclusions, in our opinion, do not appear to be entirely justified. Also, on analyzing the results in their cases in which treatment was by bursting or breaking, it is

found that the percentage of disappearance is higher than in the procedure which they recommended, in approximately the same number of cases. Rees Jensen, in considering the pros and cons as to the choice of treatment of this condition, held that of all the procedures, complete surgical excision of the sac was the surest and safest.

TABLE IV

TREATMENT IN 255 CASES (CARP AND STOUT)

Method of Treatment	Total Cases	Cases Traced (Total —70)	Recurrence	Disappearance	Lesion Still Present
Operative excision	109	35	11 (31%)	24 (64%)	
None	81	12	... .	7 (58%)	5 (42%)
Breaking	32	9	2 (22%)	7 (78%)	
Aspiration, injection and pressure	16	8	2 (25%)	6 (75%)	
Strapping and pressure	7	3	. ..	.. ....	3 (100%)
Baking and massage	5	1	. ..	. . .	1 (100%)
Aspiration and pressure	3	2	2 (100%)		
Roentgen rays	2				

Clinical Material. As in the series of cases of bursae, this collection of 102 cases of ganglion comprises the number encountered over a period of six years at the Mayo Clinic from 1928 to 1934. The pathologic findings also have been previously reported elsewhere.[16]

In the 102 cases, 104 ganglions were treated, because in each of two cases, two ganglions were present. A total of 115 therapeutic procedures were carried out on the 104 lesions. The larger number of procedures is, of course, due to the fact that a few of the patients returned for further treatment. The predominance of female over male patients is consistent with the reports of other authors as there were seventy-seven females and twenty-five males in our series. The average age of the patients of this series was 31.7 years, the oldest was aged sixty-four years; the youngest, eleven years. The average age at which the onset of symptoms occurred in this series was 28.7 years, as compared with an average of twenty-six years reported by Carp and Stout. The youngest patient was

four years of age, the oldest, sixty-four, at the time of onset. The average duration of symptoms was three years; the longest was twenty-five years and the shortest, ten days. Table v indicates the distribution of the lesions according to site. In addition,

TABLE V
ANATOMIC DISTRIBUTION OF LESIONS

Site of Lesion	Aspect			Total
	Dorsal	Palmar	Unspecified	
Hand { Right	3	2	1	6
Hand { Left	4	1	1	6
Wrist { Right	20	6	6	32
Wrist { Left	26	8	7	41
Both wrists	..	..	..	1

seven ganglions occurred on fingers of the right hand, seven on fingers of the left hand, and in three instances, the respective hand involved was not specified.

In Table vi the results of treatment are given in detail. It will be noted that in by far the majority of our cases, surgical procedures were performed. The two recorded deaths occurred some time after the patients had returned home and were in no way the result of or connected with the presence of ganglion and the instituted treatment.

Comment. We are in agreement with Carp and Stout that the reason better results were not obtained by surgical excision is that the sac had not been dissected out completely in the majority of cases so treated. This is especially true of multilocular lesions and lesions that appear to be associated with inflammation. Surgical exploration and excision would appear definitely to be indicated in those cases in which one is uncertain as to the underlying pathologic condition. Many ganglions may be found to have a definite connection with a neighboring joint cavity. To our knowledge, no satisfactory means has yet been

TABLE VI
RESULTS OF TREATMENT IN 102 CASES, REPRESENTING 104 GANGLIONS IN THE TREATMENT OF WHICH 115 PROCEDURES WERE REQUIRED

Procedure	Ganglions Treated	Cases Traced	Results					Deaths Unrelated to Condition or Treatment
			Good		Recurrence		Unknown	
			Number	Per Cent	Number	Per Cent	Number	
Partial excision	2	0	..	.....	..	....	2	
Complete excision	97	57	37	61.4	20	38.6	38	2
Excision and injection of 2 per cent formalin into wound	3	3	1	33.3	2	66.7		
Excision and injection of iodine into wound	1	1	1	100.0				
Total excisions	103	61	39	63.9	22	36.1	40	2
Incision and introduction of iodine	1	0	..	.....	..	....	1	
Breaking	4	4	1	25.0	3	75.0		
Aspiration and injection of iodine	6	6	2	33.3	4	66.7		
Aspiration and injection of iodoform	1	0	..	.....	..	....	1	
Total aspirations	7	6	2	33.3	4	66.7	1	
Grand totals	115	71	42	59.2	29	41.0	42	2

devised by which this connection may be diagnosed preoperatively.

The use of iodized oil and, in some instances, air has been resorted to in demonstrating connections between the joints and other structures such as bursae and ganglions. Because of the irritating properties of the oil and the poor contrast obtained with air, neither agent has been of much value in solving this particular diagnostic problem. However, in this connection, Dr. H. L. Day drew our attention to the work reported, in 1938, by Titus, Tafel, McClellan and Measer. After numerous clinical and experimental studies, these investigators recommended the use of a preparation composed of skiodan (40 per cent) and acacia (20 per cent) in uterosalpingography. They found this preparation to be nonirritating, quickly absorbed and rapidly excreted in the urine. Possibly this same preparation could be used in studying the connections between joints and associated ganglions or bursae. We believe this worth a trial, certainly in the experimental laboratory; if such experience were successful, clinical use of the method may be warranted.

There are other reasons, such as the presence of deformity, interference with function and cosmetic effect, which should influence the surgeon to recommend operation. When one has set apart from a series all cases that are amenable to operation, the remaining cases, most suited to other forms of treatment are comparatively few.

The method of aspiration and injection of sclerosing solutions offers certain advantages but its limitations must be realized. It is applicable only to ganglions that are definitely situated in easily approachable regions, such as the dorsum of the wrist. Repeated aspirations and injections are usually necessary because a single treatment rarely produces a cure. In fact, failure is almost certain to follow a single treatment. The procedure has the advantage of not leaving a scar. In a limited number of carefully selected cases we believe that it is a useful method.

The employment of general anesthesia with a tourniquet placed on the affected extremity insures the best conditions for complete surgical excision. The tourniquet not only prevents hemorrhage during the operative procedure but also prevents red discoloration of the exposed tissues of the operative site. This discoloration interferes to a great degree with the accurate identification of tissues that is essential to the delicate dissection required for the removal of a ganglion. The objection to general anesthesia will be minimized by the use of an intravenous anesthetic agent such as sodium pentothal. With the administration of this agent, anesthesia is produced easily and the after effects are negligible.

It is not our primary purpose in this paper to advocate any hypothesis as to the genesis of the ganglion, but we do believe that the strongest argument appears to lie in favor of the hypothesis of mucinous degeneration of the periarticular connective tissue. There might be predisposing factors such as embryonic rests or cysts, but we do not think that these have been satisfactorily demonstrated.

The work of H. T. Jones and others indicates that the ganglion and the cystic bursal hygroma are the results of one pathologic process and we are in agreement with this concept. For this reason and for others, such as the similarities in histologic structure and fluid contents, we are inclined to classify the ganglion anatomically as an adventitious type of bursa, and from the standpoint of disease, in the class of cystic manifestations along with cystic bursal hygroma. We have mentioned the matter of function as an objection to such a classification, but we are of the opinion that the reasons favorable to such a consideration outweigh this objection and others.

SUMMARY

Thirty-seven cases of bursitis have been encountered over a period of six years. These cases were susceptible of classification on an etiologic basis into acute and chronic types, each of which was further

subdivided. Forty-one bursae were removed surgically and to our knowledge, only eight of these have recurred since operation. Eight known different diseases affected the forty-one bursae which were removed and trauma was the most common cause of chronic bursitis in this group of cases. Complete excision is the procedure of choice in the treatment of chronic bursitis that is associated with persistent swelling and disability. Chronic subdeltoid bursitis should be treated conservatively, unless such measures have proved to be ineffective.

One hundred two cases of ganglion have been encountered over a period of six years. These cases represented 104 ganglions, in the treatment of which 115 surgical procedures were used. The ratio of males to females was 1:3. Of these 102 cases, permanent results of treatment have been determined in seventy-one. From all methods of treatment, good results occurred in 59 per cent of cases. Of the various treatments employed, complete surgical excision of the sac offered the best results.

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"WEEPING sinew" or "ganglion" (tenosynovitis) forms a fluctuating, spindle-shaped swelling along one of the tendons of the wrist, slow and almost painless in its course.

THYMOMA—AN UNUSUAL CASE*

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EWING[1] classifies thymic tumors into two main groups: (1) Lymphosarcoma or thymoma which is the most common form of thymus tumor, and (2) carcinoma which arises from reticulum cells.

Ewing[2] states that their weight at birth is 2 to 14 Gm., averaging 7.7 Gm., and they increase in size to the fifteenth year when the average weight is 20 to 28 Gm. A strict encapsulation has been an outstanding feature.

Parker[3] states that the first operative treatment of thymus tumor to relieve respiratory distress in man was given by Rehn in 1896.

In 1907, Jackson[4] was the first to observe tracheal stenosis by means of the bronchoscope in a patient with a large tumor of the thymus.

Ochsner and Doubler[5] mention that the thymus and the sexual organs in man and in animals work antagonistically, and the removal of the thymus gives rise to hypertrophy of the testicle and vice versa.

Helvenstine[6] shows that the thymus, being of both mesodermal and entodermal origin, may give rise to sarcoma, carcinoma or mixed carcinosarcoma tumors. He reports two of his cases and states that Rubaschow was able to collect sixty-nine cases of thymic tumors, fifty-two of which were sarcoma and twelve carcinoma.

Jones[7] reports a thymus tumor in a patient with myasthenia gravis and he states that in fifty-six autopsies of myas-

thenia gravis recorded since 1901 about half the cases showed thymic involvement.

Speed[8] experienced a case of a large thymic tumor with metastasis to the supraclavicular space and enlargement of the thyroid with symptoms of hyperthyroidism. The importance of a roentgenogram in this type of case with bulging in the neck was stressed.

In their report Symmers and Vance[9] state that lymphocytic tumors occur most often in persons under thirty-five; of those many are in children.

Bren and Wechsler,[10] in their two cases reported, bring out the association of myasthenia gravis with sudden death. The autopsies showed tumors of the thymus gland; both their cases had been previously diagnosed as encephalitis.

Symmers[11] reviewed a large series of twenty-five of his own collected cases from Bellevue Hospital, New York. He brings out the absence of early signs and states that at least five different types of growth are likely to arise from the thymus gland, namely, perithelioma from the connective tissue of the walls of small blood vessels, lymphosarcoma from the lymphocytic elements, endothelioma from the endothelial reticulum cells, spindle-cell sarcoma from the connective tissue framework and Hodgkin's disease which finds the necessary prerequisite for development in the lymphocytes of the thymus.

Crosby,[12] in 1932, reviewed all the literature and brought the subject of malignant

tumors of the thymus up to date with a total of one-hundred sixty-six cases, of this large group one-hundred twenty-two were

that they are best not operated upon; if absolutely necessary a preoperative course of x-ray should be given.
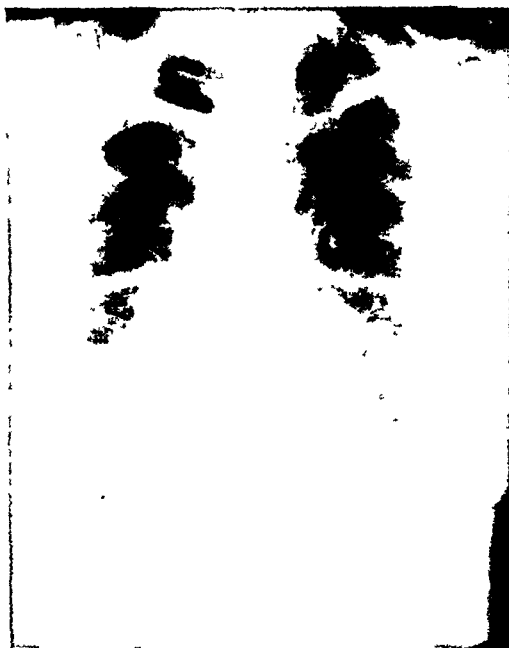
FIG. 1. Showing a rounded mass above the right auricular curve, projecting into the right lung field.

FIG. 2. Lateral view revealing mass lying anterior to heart shadow.

so-called sarcomas and forty-four were carcinomas. He states that the term thymoma was first used by Grandhomme in 1900.

Norris,[13] in 1936, stated that 50 per cent of reported autopsied cases of myasthenia gravis showed some thymic involvement. He reports four cases of thymomas with typical myasthenic symptoms such as difficulty in mastication, restlessness, dysphagia and spasmodic dyspnea.

Janeway,[14] in 1920, reported on three cases of tumors of the anterior mediastinum treated with radium with encouraging results. He infers that radium and x-ray offer to some definite relief with a prospect of cure.

Craver[15] admits that some thymic tumors are radioresistant. A good point he brings out is that treatment by x-ray is an important differentiating procedure in the differential diagnosis between aneurysm and thymic tumor.

Henson,[16] speaking of thymic enlargement in children with symptoms, states

Andrus and Foot[17] report a most unusual case of thymic tumor in a boy aged thirteen with the largest tumor reported up to that time, weighing 2,235 Gm. It was removed surgically with the recovery of the patient.

Rogatz,[18] in May 1939, reviews the clinical studies and autopsy findings in an infant two and one-half months of age with lymphosarcoma of the thymus.

CASE REPORT

The patient, a white female, aged sixty, was admitted to the Millard Fillmore Hospital on December 2, 1937, complaining of shortness of breath. Over a period of years this had gotten progressively worse until she could hardly walk around the house. In the four months previously she had developed paroxysmal coughing attacks which came on at any time. Talking had become increasingly difficult as it brought on attacks which exhausted her completely. She had had nocturnal dyspnea since May 1937. No hemoptysis had been present although she at times expectorated some brownish mucus. There were no night sweats. She had

lost a few pounds recently, and had developed some fear of eating, as the excessive coughing at times resulted in nausea though she seldom vomited. The patient also complained of being tired, but that she could not rest or sleep due to the aggravating cough.

She had had whooping cough, measles and mumps in childhood. There was no history of tuberculosis, diabetes or cancer in the family.

Examination revealed a well nourished, somewhat obese, white female aged about sixty, with an anxious expression. She was slightly dyspneic in bed. No clubbing of the fingers was seen. The positive physical findings were confined largely to the chest.

There was a moderate enlargement of the thyroid gland. The throat was negative for pathology. Chest movements on respiration were free and equal on both sides. The trachea was not displaced. Auscultation of the lungs disclosed crackling râles in the right apex anteriorly, musical and crackling moist râles throughout the right chest posteriorly. The heart was regular and of fairly good tone; no murmurs were heard. There appeared to be widening of the base of the heart both to right and left. The pulse was of good quality; the blood pressure taken lying down in bed in the right arm was 130 systolic, 76 diastolic; the left arm was 114 systolic, 60 diastolic. The abdomen was obese, not distended. The liver edge could be made out about two finger-breadths below the right costal margin; it was not tender and no other masses could be felt. The lower extremities were negative, no edema being present.

The urine on several occasions was negative except for an occasional granular cast. Her blood on admission showed 80 per cent hemoglobin 4,264,000 erythrocytes, 8,800 leucocytes: 62 per cent neutrophiles, 38 per cent lymphocytes. On examination the sputum showed a moderate number of pus cells, a moderate number of organisms including staphylococci and streptococci; no acid-fast bacilli were found. The Wassermann test was negative. Roentgenograms taken of the chest revealed a moderate emphysema in both lung fields. The heart shadow appeared normal in size but revealed a rounded mass projecting from its right border just above the right auricular curve, the mass being about 2½ cm. in diameter and projecting into the right lung field. Fluoroscopically this shadow appeared

inseparable from that of the heart, lying slightly anteriorly and showing pulsation. A kymographic study revealed that this pulsation was identical with that of the auricle.
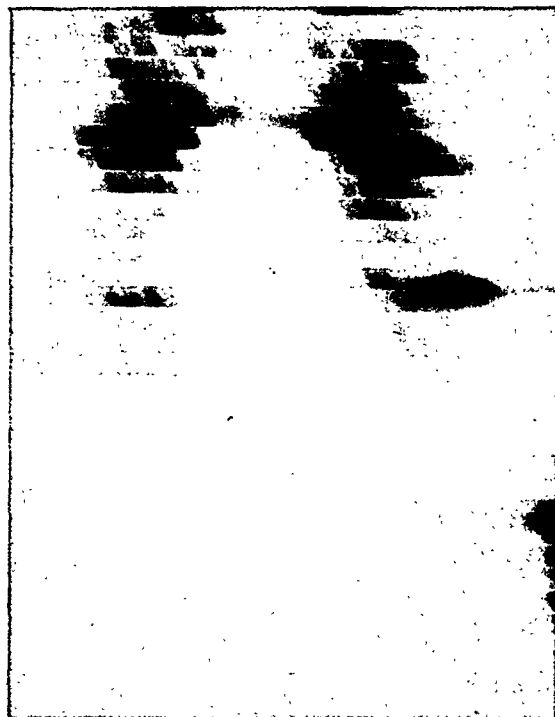
Fig. 3. Kymographic study showing pulsation identical with that of the auricle.

In the absence of a positive diagnosis by roentgenography and to rule out a bronchogenic tumor the patient was bronchoscoped on December 6, 1937, using local anesthesia. The examination revealed no pathology within the bronchi.

In view of the history and the tumor mass seen on x-ray with negative bronchoscopy findings a diagnosis of a right mediastinal tumor was made and an exploratory operation to determine its operability was performed on December 8, 1937.

The patient was anesthetized with cyclopropane and an incision was made from a point just beneath the right clavicle in a curved manner to a point opposite the anterior cartilage of the fourth rib at its sternal junction. The sternum and ribs were exposed and the cartilaginous portions of the second, third and fourth ribs removed. In order to get a better exposure a portion of the sternum at this location was rongeured away reducing its width at this point to about one-half. The pleura and pericardium were seen and the tumor mass could be palpated through the pleura and

appeared to pulsate with the heart beat. The pleura was incised. The underlying tumor mass had a whitish gray appearance.

operatively because of thick mucus in her throat which was difficult for her to "bring up."
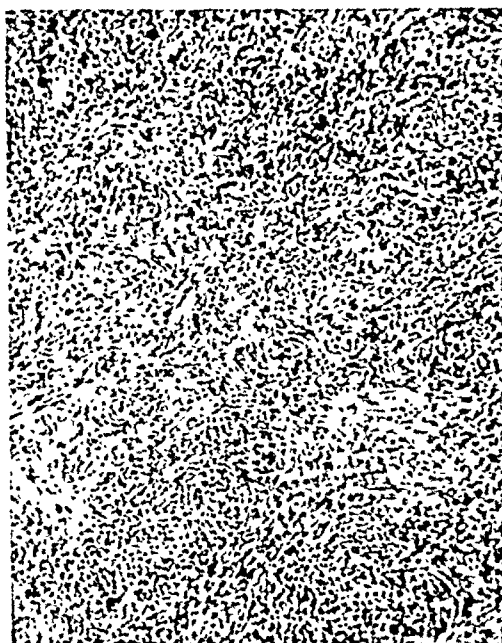
FIG. 4. Photomicrograph of tumor tissue showing spindle cells in whorls with diffuse lymphocytic infiltration. × 100.
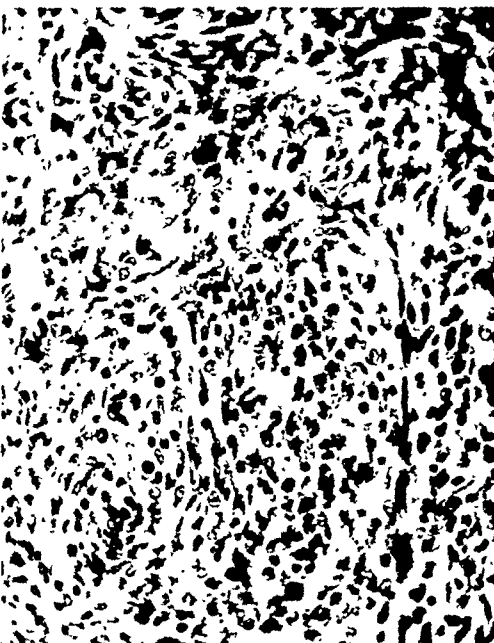
FIG. 5. Photomicrograph showing spindle cells in whorls; diffuse lymphocytic infiltration. Order of growth suggests endothelial proliferation. × 750.

A mediastinal tumor measuring about 9 by 7 by 4 cm. was exposed. The tumor was adherent to the pericardium over the right auricle, the upper portion being on a level with the arch of the aorta. The capsule of the tumor was incised and the tumor shelled out with comparative ease. Its attachment on the medial side was clamped, cut and tied off with chromic catgut and the wound was closed. The pleura was sutured with a continuous layer of chromic catgut, the muscles sutured together and three kaldermic retention sutures placed through the skin, subcutaneous tissues and fascia. The skin was closed with Michel clips. The operation lasted forty-seven minutes and the patient stood the procedure very well, being returned to her room in good condition.

The first five postoperative days were quite uneventful the temperature never rising above 102°c. rectally and dropping to 99°c. orally the second postoperative day. The pulse varied between ninety and one-hundred-ten per minute and was of good quality; respirations ranged between eighteen and twenty-eight per minute. The patient was given oxygen post-

On the second postoperative day the patient commenced to cough and complained of considerable mucus in her throat with inability to "bring it up," the mucus being quite thick and tenacious. Oxygen was administered to combat this. Five days following her surgery the patient was still coughing and now began to cough more violently and at times continuously. About this time she complained of pain in her chest at the operative site. The dressing was changed and the wound appeared to be normal. The chest was strapped with adhesive tape to limit excursions of the anterior chest wall. Oxygen was continued at frequent intervals and helium was also administered, using 80 per cent helium and 20 per cent oxygen. However, the coughing continued and was very harassing, not responding to the usual medications.

On the seventh postoperative day the patient complained of pain at the site of her operation and a peculiar instability of the front of her chest with a thudding sound and a rubbing sensation at her sternum when she coughed or breathed. Examination at this time revealed a definite break in the sternum with some over-

lapping of the fractured fragments; the thud could be heard on respiration. The coughing at this time was painful, frequent and severe.

On December 15, 1937, the patient was again taken to the operating room and under cyclopropane anesthesia an incision was made over the midsternum disclosing a complete fracture in its upper portion through the previously rongeured area. The fragments were overriding. A four hole Lane's plate was screwed into position to maintain reduction. No evidence of infection was seen. The wound was closed in layers. The patient was returned to her room in fair condition.

Following this procedure the patient's condition became progressively worse; her coughing was not improved; there was some cyanosis when the oxygen administration was stopped, and she was expectorating yellowish, thick mucous. The patient's condition declined, her temperature rose to 103.5°C. rectally, pulse one-hundred-forty per minute, respirations shallow and to thirty-eight per minute. She expired December 16, 1937.

I quote here the pathologist's report: "Gross examination of the tumor shows a lobulated, irregularly, pear-shaped tumor mass measuring 8 × 7.5 × 3.5 cm. and weighing eighty-five grams. Cut section reveals numerous lobulations of soft, grey-brown tissue. Many of these are enclosed in a thin fibrous capsule. Gross and visible characteristics suggest thymus, having the appearance of sweetbread. Interstitial hemorrhage is present in several lobules. Consistence of tumor tissue is that of fish flesh.

"Microscopic sections of the tumor shows spindle cells, often in whorls and well supplied by capillaries of which the spindle cells form the walls, are diffusely infiltrated by lymphocytes and tend also to form abortive follicular formations around lymphoid cell aggregates. Fibrous stroma is very scant and a few slender trabeculae are noted. Order of growth suggests endothelial proliferation rather than that of a nerve sheath sarcoma. Impression is derived that although locally malignant, this tumor is probably not prone to metastasize. Diagnosis: Thymoma (endothelial type)."

Autopsy was performed and reported by Dr. Norman W. Elton as follows:

"The body is that of a well developed and well nourished elderly female of the pyknic constitution. Body length is 65½ inches.

"Abdominal wall shows numerous old striae of previous pregnancy. Eyes are not examined, since the head and face have been prepared for funeral. On the anterior chest wall there are two long incisions one concave outward and parasternal on the right, measuring 20 cm. in length sutured by a continuous dermal stitch. The other, more recent, lies in the midsternal line, is 18 cm. in length, and the skin edges are coaptated by Michel clips. Reopening of the incisions reveals a fracture of the sternum just below the sternomanubrial junction, repaired by a four-screw metal plate of Lane type. This plate is lifted out without difficulty, screws coming readily out of sternum. Right border of sternum in the region of the second and third ribs has been ronguered with removal of half its substance. To facilitate examination the complete sternum is removed, exposing the tumor site in right upper pericardium mesial to parietal pleura. Base of the tumor site is markedly thickened and indurated and grossly appears to consist of unremoved tumor tissue. Parietal pleura lateral to the tumor site has been sutured. Base of the tumor site measures some 7 × 4 cm. with a ragged meaty surface.

"Lymph-nodes of upper and posterior mediastinum are markedly enlarged, with black centers and pale peripheries on cut section. Nodes at bifurcation of trachea are especially large, one measuring 2 × 4 × 2 cm.

"Right diaphragm attains the fourth rib; and the left diaphragm is also at the level of the fourth rib. Presence or absence of fluid in pleural cavities cannot be determined because of escape of embalming fluid, but both lungs are voluminous and fill the pleural cavities completely. Left lung weighs 525 grams; right lung weighs 700 grams. Each is rubbery in consistence and an abundance of clear frothy fluid pours from their cut surfaces on squeezing. Posterior surface of right lower lobe exhibits several old fibrinous plaques in visceral pleura. There is no evidence of pulmonary tumor metastasis. Heart weighs 300 grams. Its myocardium is firm and beefy red and all valves and coronaries are normal. Heart measurements are as follows:

	Cm.		Cm.
AV	—6.5	PV	— 8.0
MV	—7.0	TV	—11.0
TLV	—1.9	TRV	— 0.5

"Trachea is of somewhat reduced caliber. Aortic intima is smooth and shining.

"*Abdominal cavity* is explored through the diaphragm. Bowel is greatly distended with gas. No stones are palpable in the gallbladder. Uterus and adnexa are not remarkable. *Kidneys* are firm and normal in shape and size. *Spleen* is small and firm. *Liver* is somewhat enlarged, but its lower edge is sharp. It is yellow on cut section with poor definition of anatomical markings.

ANATOMICAL DIAGNOSIS

1. Upper mediastinal tumor with operation therefor, and residual tumor tissue in anterior upper pericardium.
2. Pulmonary edema.
3. Traumatic fracture of sternum and operation therefor.
4. Mediastinal lymphadenopathy.
5. Fatty infiltration of liver.

MICROSCOPIC SECTIONS

"*Lymph nodes* from the mediastinum show only reticular hyperplasia and dilated vascular channels containing many polys. There is no evidence of tumor.

"*Lung:* Pleural mesothelium shows a marked thickening due to proliferation of histocytes, some of which are multinucleated. Beneath this area many groups of alveoli contain a purulent exudate. Reaction is also noted about bronchioles.

"*Liver:* Bile retention grade 1. There is also a low grade fatty infiltration. Stroma shows light lymphocytic infiltration, with foci of increased density.

"*Tumor site* shows only recent intensive fibroblast proliferation involving fatty tissue. No residual tumor is noted.

MICRO DIAGNOSIS

1. Bronchopneumonia
2. Acute mediastinal lymphadenitis

FINAL DIAGNOSIS

1. Thymoma (endothelial type) and operation therefor
2. Pulmonary edema
3. Bronchopneumonia
4. Traumatic fracture of sternum and operation therefor

5. Acute mediastinal lymphadenitis
6. Fatty infiltration of liver"

CONCLUSIONS

1. We believe that in a similar case it is unnecessary to rongeur away any part of the sternum.
2. Lane plating of the sternum is not feasible as the screws will not hold.
3. The sternum of older individuals is brittle and appears to fracture easily when its width has been decreased.
4. These tumors when encapsulated as the one reported here are easily shelled out and removed.
5. We believe that this patient had an excellent chance of recovery had she not fractured her sternum.

SUMMARY

A case is reported of an operated comparatively nonmalignant, rare, mediastinal thymic tumor, with endothelial characteristics, weighing 85 Gm. and with its capsule attached to the pericardium of the right auricle. The clinical and pathologic features are discussed along with a review of the literature to date. It did not present the often accompanying signs of myasthenia gravis.

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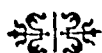
Owing to its connection (thyroid tumor) with the larynx it moves up and down somewhat when the patient swallows, but is not attached to any other structures in the neck. The enlargement is often unilateral or largely so.

RETROPERITONEAL MULTILOCULAR CHYLANGIOMA CYST WITH CALCIFICATION*

REPORT OF A CASE

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CHYLANGIOMAS are considered benign cystic tumors of the lymphatic system. They are rare conditions and belong to the group of retroperitoneal cysts. Most of the records of retroperitoneal cysts are to be found in postmortem findings or reported as accidental discoveries made during surgical intervention for a mistaken diagnosis which, in case of larger tumors, was frequently ovarian cyst. Clinical diagnosis is seldom made before operation even today.

The following case report is comparable to two other cases which are the only ones available in the literature. It is especially interesting since the clinical diagnosis could be made before operation from the location of the cyst, and from the unusual roentgenologic findings.

CASE REPORT

M. B., a white girl, aged 5 years, was admitted to Gouverneur Hospital on December 8, 1938. According to the father's description, one week prior to her admission he had observed that the child's skin became yellow and that the child passed red urine. Four days later, the child vomited twice; two days after that the patient complained of abdominal pain in the region of the epigastrium.

The history of the patient's early infancy was negative. At 2½ years, the child had had measles followed shortly thereafter by whooping cough. At 3 years of age pneumonia was contracted. Four years prior to the present admission, a hemangioma had been removed from the region of the patient's left calf at Gouverneur Hospital. Two years later the child was operated upon at another hospital, when a cavernous hemangioma was partially excised from the lateral surface of the left thigh. It is interesting to note that one year previous to her present admission, roentgenograms of her extremities and chest were taken but none of her abdomen, therefore, her described condition remained unknown until abdominal symptoms appeared. The site of the operation became infected and responded sluggishly to treatment.

The family history was negative. Father, mother and two siblings were living and well.

Physical examination revealed the following pertinent findings: The patient was a well-nourished, white girl who was lying in bed in no apparent distress. Her eyes showed an icteric tinge to the sclera. The mucous membranes of the nose were injected. The ears were negative. Her neck showed no lymphadenopathy. Heart and lungs were normal. Abdominal examination revealed a soft, non-tender abdomen. The liver margin was palpable 2½ fingers below the costal margin at the right mammary line. The edge of the liver was smooth, and not tender. Neither spleen nor other masses were palpable. There was a small healed scar at the left side of the lower abdomen. Near the interrectal cleft, there was a hemangioma measuring about 2½ × 1 cm. A small pedunculated skin tag was located near the anus. In addition, there were many other hemangiomas ranging in size from a pinhead to ½ cm. mostly on the left lower extremities, but also sparsely scattered over the other extremities and the body. Genitalia and rectum were negative. The extensor surfaces of the elbows and knees showed patches of psoriasis. A healed scar was present on the lateral aspect of the left leg.

The admission diagnosis was: (1) acute catarrhal jaundice; (2) multiple hemangiomas; and (3) psoriasis.

Routine flat plate examination of the abdomen revealed a large circumscribed shadow in the left iliac region, measuring about 7½ × 9½

large mass in the left side of the abdomen was found to be located outside the colonic tract. (Fig. 5.) An attempted pneumoperitoneum

FIG. 1. Flat plate of abdomen. The calcified deposits in the cyst wall clearly outline the cyst situated in the left lower quadrant of the abdomen.
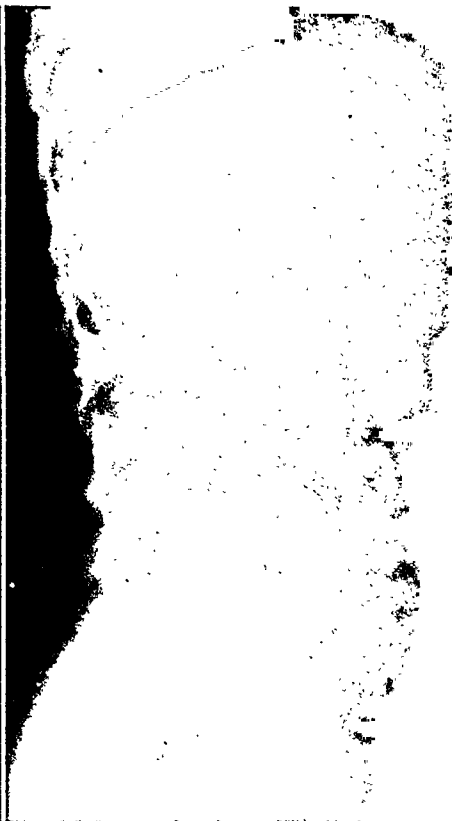
FIG. 2. Flat plate of abdomen; lateral view. The situation of the cyst in this view suggests its retroperitoneal location.

cm., situated rather posteriorly in the abdomen. (Fig. 1.) A side view showed the same at the posterior abdominal wall. (Fig. 2.)

An intravenous urogram was done to determine the association between the cystic mass and the urinary tract. (Fig. 3.) Both kidneys showed normal function. The pelves and calyces of both kidneys were completely filled in outline with no dilatation. The urographic studies showed the presence of a large cystic mass in relation to and apparently causing dilatation of the left ureter. The lack of mobility of the mass, its location and relationship to the ureter suggested that it was situated retroperitoneally. The right ureter and bladder were normal. Retrograde pyelography (Fig. 4) confirmed these findings and established the fact that both kidneys were normal in size, shape and position.

A barium enema examination showed the colon to be completely filled from the rectum to the cecum with no defect in outline. The

examination contributed little towards the further differentiation of the mass. Examination of the chest and long bones was radiographically negative.

It is interesting to note that repeated abdominal examination over a period of several weeks and by many examiners failed to reveal a palpable mass, although the presence of this mass had been thoroughly demonstrated radiographically. However, shortly after ether anesthesia was employed for retrograde pyelography, the mass could be felt definitely. Clinically, the mass at this time was reported as cystic located on the left side of the abdomen, the upper pole of which measured about 5 cm. below the left costal margin and the lower pole about 3 cm. above the anterior superior spine. Two days after the anesthesia had been administered, the mass was no longer discernible on palpation.

Laboratory studies were replete with negative findings. Urine examinations were re-

peatedly negative for bile, albumin and sugar; specific gravity varied from 1.010 to 1.030. Fecal specimens were negative for typhoid, paratyphoid or dysentery. Blood chemistry

their anterior surfaces with the cyst wall in the manner characteristic for hygromas found adjacent to muscle tissue in other parts of the body.
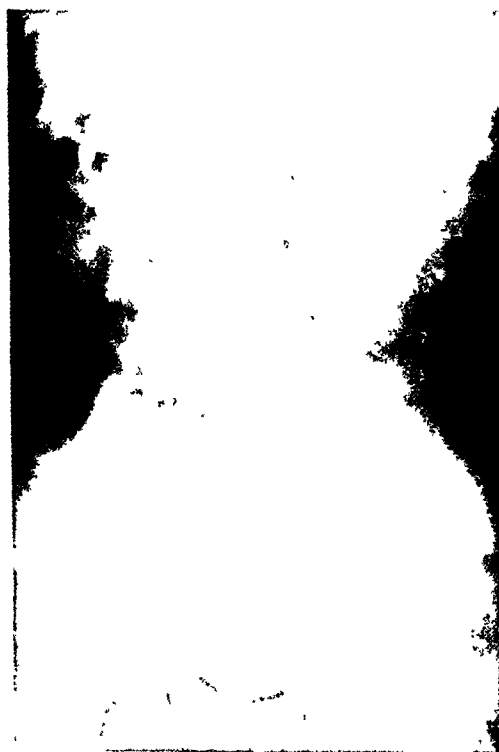
FIG. 3. Intravenous pyelogram. The left ureter is slightly dilated. The cyst lies just lateral to the ureter and is evidently exerting pressure thereon.

FIG. 4. Retrograde ureteroscopy; oblique view. This view demonstrates the extra-urinary location of the cyst.

findings were: N.P.N. 28, sugar 100, icteric index 8, cholesterol 130, cholesterol esters 93, total protein 6.0 per cent, albumin 3.3 per cent, globulin 3.6 per cent.

To avoid complications, it was believed that surgical removal of the mass was indicated.

Operation. The abdomen was opened through a left external rectus incision. The cyst was easily identified as it presented internal to the descending colon and protruded well into the abdominal cavity. An incision into the peritoneum was made parallel to the external border of the descending colon. The colon was dissected medially exposing the fibrous coat of the cyst. (Fig. 6.) Blunt enucleation of the cyst could not be done because of the fibrous attachment to the retroperitoneal structures. A careful dissection of the cyst was made during which it was freed from the ureter which ran across the anteromedial surface. The quadratus lumborum and psoas muscles were blended on

The wall of the cyst was perforated during the dissection of the upper pole from the fatty capsule of the kidney. A strand of fibrous tissue was noted attached to the upper pole which ran behind the kidney and extended upward, in the kidney space toward the left crus of the diaphragm. Upon opening this strand of fibrous tissue, a cavity with a lining resembling the wall of the larger cystic cavity was found. With the probe in place the fibrous tract was dissected out up to and behind the crus of the diaphragm where it ended near the twelfth dorsal vertebra. (Figs. 6, 7 and 8.)

Repair of the opening in the posterior peritoneum was performed, which replaced the descending colon. A drain was inserted through the lower angle of the wound into the kidney space.

The postoperative course was uneventful. Follow-up examination showed the child apparently well. (Fig. 9.)

DISCUSSION

In this retroperitoneal multilocular cyst with calcification the cavities were not in direct communication. The cystic material resembled a seromucinous substance and only the larger cyst was walled with extensive calcareous deposit. Goedel's[1] post-mortem finding in a man of 20 is very interesting as it bears some relation to our case. In this case there was a multilocular chylangioma of the mesentery of the hepatic flexure, intraperitoneally and retroperitoneally. The latter was located behind the ascending colon in the angle between the vertebral column, right kidney and liver. The cyst showed endothelial lining surrounded by proliferating connective tissue stroma. In some of the old, thick-walled cysts the endothelium had entirely disappeared, and there remained only calcified detritus. It is supposed that younger, thin-walled cysts are lined with endothelium, and its absence may be explained by the fact that the endothelium, in time, undergoes hyaline and fatty degeneration and is absent in cysts of long duration.

Smoler[2] noted that the presence and absence of endothelial lining of the cyst wall are reported by equal numbers of authors. In all cases there seems to have been a lining of the lymph spaces within the cyst wall proper. Whether these cysts develop from varicosities of the preformed lymph vessels, or should be classed as new growths or retention cysts, is a matter still under discussion.

The second report that is related to this case is that of Swartley.[3] This concerned a girl, 7 years of age, with a mesenteric cyst of the ileum the size of a grapefruit. The wall showed three layers: inner serous, middle muscular and a thick fibrous envelope undergoing calcareous changes.

Etiology. Retroperitoneal cysts are believed to develop from the congenital remnant in the mesentery or retroperitoneal space of the Wolffian and Müllerian ducts or from the vitelline ducts in connection with Meckel's diverticulum. Such

cysts are found in all ages but more frequently in young females. Hadley[4] states that cysts are formed as a result of the

Fig. 5. Barium enema examination. The cyst is demonstrated to be extracolonic and to lie medial to the descending colon.

abnormal development of the primitive lymph sac. According to Dowd:[5] "Chylous cysts are really pre-formed cysts situated in such close relation to the lacteals that chyle has been effused into them and that they are really embryonic in origin, in structure similar to ovarian and parovarian cysts." Cysts may also originate in degenerated lymph-nodes as is occasionally observed elsewhere in the body. (Rokitansky, Virchow.) The lymphatic and chyle cyst may also develop under certain circumstances as a result of obstruction in the retroperitoneal lymph system. This, however, must be rare because of the collateral circulation (Gerster).[6]

Location. These cysts may be located anywhere in the mesentery of the small or large bowel or in the omentum. Retroperitoneally they are more frequent at the right
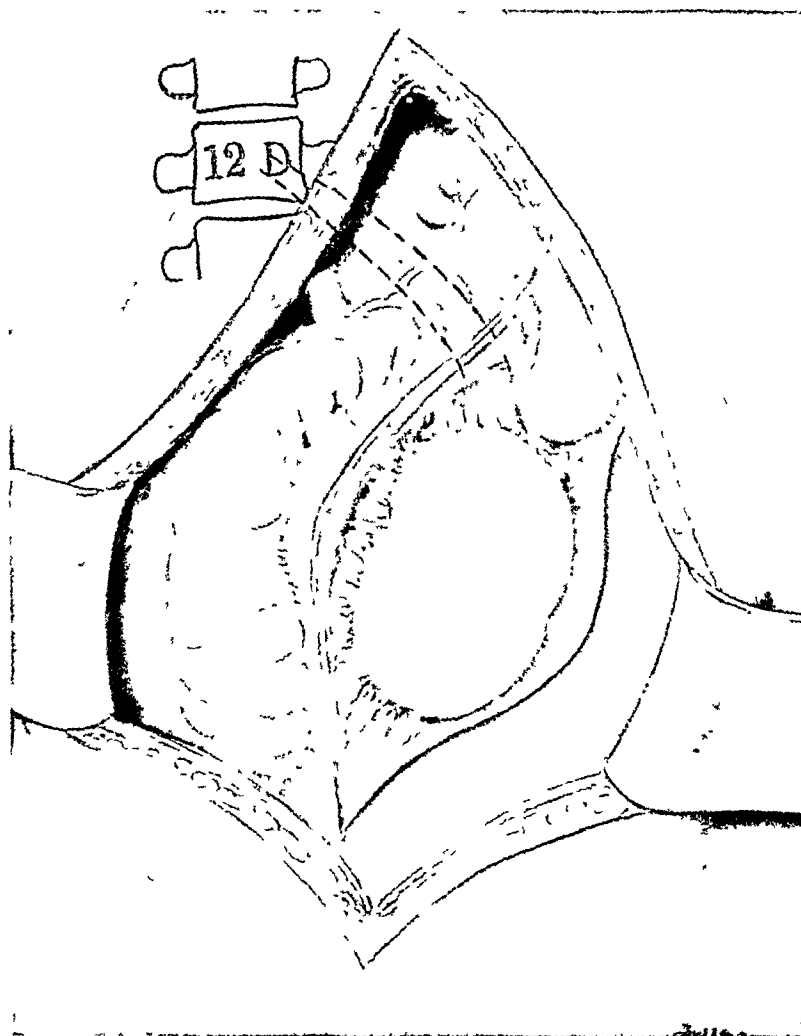
FIG. 6. The operative approach, appearance and location of the cyst.
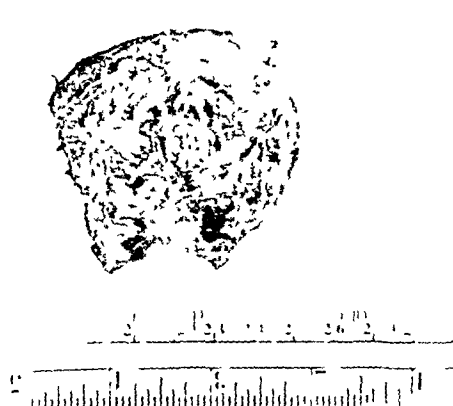
FIG. 7. Gross specimen. The cyst, which had been opened before this photograph was taken, has been folded back and reshaped to simulate its original shape and size at operation.
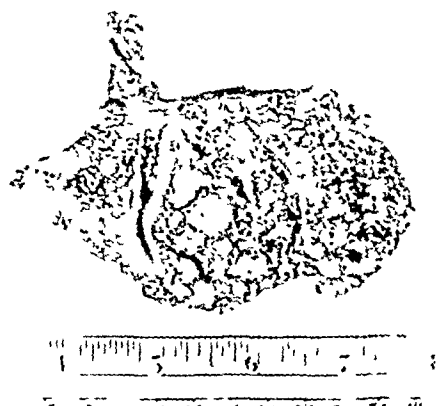
FIG. 8. Gross specimen. The cyst has been opened and flattened out. The white areas are calcific deposits in a wide variety of size ranging from minute deposits to calcified plaques ½ inch in diameter.

or left lower quadrant of the abdomen but may be found at any other location of the posterior retroperitoneal space.

Classification and Origin. The retroperitoneal cysts are classified according to Hanfield-Jones[7] as urogenital, mesocolic, inclusion, lymphatic, traumatic, blood and parasitic retroperitoneal cysts. Lahey[8] groups the mesenteric, omental and retroperitoneal cysts together as retroperitoneal cysts since they are all merely an anterior extension or inclusion of the originally retroperitoneal structure. This, of course, may be true for the cysts of congenital origin, but we cannot accept this classification for all mesenteric and omental cysts as some of them may be formed later in adult life by obstruction of chylous, lymphatic ducts, traumatic blood cysts, or by parasites, etc. Therefore, the designation of omental and mesenteric cysts is justified in contrast to retroperitoneal cysts.

All these cysts according to Moynihan[9] may be: (1) serous, (2) chyle, (3) hydatid, (4) blood, (5) dermoid and (6) malignant retroperitoneal cysts.

The retroperitoneal chylous cysts are actually cystic lymphangiomas. They are unilocular or multilocular. Generally they contain chylous, milky, mucinous, serosanguinous, bloody or straw-colored fluid. Dermoid cysts contain sebaceous material, hair or teratoid tissue. The cysts are thin or thick-walled tumors, usually benign. Warfield[10] found malignancy in less than 1 per cent. Malignant cystic tumors are usually sarcomas.

Some such cysts may be differentiated also by the naked eye, e.g., the urogenital cysts are bluish, thin-walled, single cysts containing clear serous fluid and are situated near the kidney. One of the varieties of the urogenital cyst is the fimbriated Müllerian cyst. The mesocolic cyst, according to Hanfield-Jones,[7] is formed during the rotation of the colon between the mesentery and parietal peritoneum. Among the inclusion cysts, the dermoid and the teratomatous cysts are rare and do not differ from similar cysts found elsewhere in

the organism. In parasitic cysts usually echinococci have been observed. The omental, mesenteric and retroperitoneal cysts

Fig. 9. Postoperative flat plate of the abdomen.

are not common findings. There are about 550 cases reported in available literature, but one may assume that many such findings remain unreported. However, according to Dr. Gerster, the most careful search in the literature reveals only sixteen or eighteen retroperitoneal cysts. Therefore, ours may be considered as the nineteenth, and the third in which calcification was noted.

Pathology of Specimen in Reported Case. According to the pathologist, Dr. M. Kopel, the gross specimen consisted of a cystic mass measuring about 5 × 5 × 6 cm. which had been opened and flattened out. The wall of the cyst was 2 mm. thick and contained many irregular patches of calcified tissue. (Fig. 8.) The surface of the cyst was fibrous, hemorrhagic, discolored and showed some dilated blood vessels. In some areas the lining was rough and had the appearance of squamous epithelial

tissue. Microscopic examination showed that the cyst wall was composed of dense fibrous tissue which in some areas was calcified. Thickened blood vessels were present; in some areas the lining of the cyst consisted of a calcified plaque. In others, small papillary projections were seen lining the cyst. No definite epithelial layer was seen, however. The pathologist's diagnosis was: retroperitoneal, multilocular, calcified cyst.

Symptomatology. Reviewing the findings of Moynihan,[9] Peterson,[11] Berger[12] and others, one may admit that many such cysts cause no symptoms whatever. This may be the case when they are small with insidious development manifesting only undefined abdominal complaints, which may not interfere with the function of the abdominal organs. Many, however, are admitted to the hospital as acute surgical subjects. In such patients the pain is more or less acute, sometimes localized, and radiates to the groins, thighs or flank. But, according to Berger[12] and Rokitansky, in the majority of cases pain failed to localize. Nausea and vomiting and other signs of intestinal obstruction or peritonitis are present after the cyst has been ruptured or torsion has occurred. Retroperitoneal cysts with a chronic course produce only occasional abdominal pain and indigestion beside the physical findings of the tumor present. Rapid emaciation was noted by Moynihan[9] and marked loss of weight by Berger and Rothenberg.[12] The variation of symptoms may be explained by the location and size of the tumor mass, which is palpable in about 75 per cent of the patients. Abdominal tenderness on examination is frequently present. Percussion may give information with characteristic dullness over the mass, surrounded by an area of resonance. The presence of albuminuria was noted in 50 per cent of the patients by Berger.[12] X-ray findings are of great diagnostic value, as illustrated by our reported case. Gerster[6] reported a retroperitoneal chyle cyst also visible on x-ray; he pointed out that the higher calcium content of the cystic fluid may have accentuated the visibility of the cyst.

Differential Diagnosis. A clinical diagnosis has been made only exceptionally. These cysts escape attention because of their rarity or the fact that they are masked by an acute condition. They are frequently diagnosed as ovarian cyst, cyst of the kidney, abdominal tumor such as that of the kidney, liver, gall-bladder, spleen or pelvic tumor, also as cyst of the urachus, pancreas or cold abscess. Space does not permit a detailed discussion, but it seems to be a good plan to have a systemic x-ray examination to aid in the diagnosis. To reach a fairly accurate diagnosis the elimination of urogenital and gastrointestinal pathology is a prerequisite.

Complications and Treatment. Such cysts after reaching sufficient size (2 to 4 inches in diameter) may compress adjacent intestinal loops, thus causing partial or total obstruction. Peritonitis may occur from rupture or torsion of the cyst. Compression of the ureter may cause hydronephrosis.

Treatment. The treatment is surgical. Complete enucleation is often possible when the line of cleavage has been found and followed. If complete excision is not feasible under the circumstances, simple incision of the cyst followed by drainage or marsupialization has been recommended. Well-planned, but not too extensive surgery prevents postoperative complications. Recovery is usually smooth as it was in our case; however, prognosis depends, as Gerster[6] pointed out, on the patient's general condition at the time of the operation and on the mechanical ease or difficulty of removal or marsupialization.

SUMMARY

A case of retroperitoneal, multilocular, calcified, chylangioma cyst in a girl of 5 years is presented as an unusual finding, inasmuch as the preoperative diagnosis could be made with the help of systematic roentgenograms. Operation was followed by uncomplicated recovery. This case is

comparable to only two other reports in the literature.

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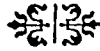
CYSTIC kidneys are usually congenital, but usually produce no symptoms until they have attained a considerable size, and hence are often overlooked or discovered accidentally in patients wholly without renal symptoms.

PRIMARY NONEPITHELIAL TUMORS OF THE STOMACH*

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THERE has been a general belief that nonepithelial tumors of the stomach are rare and discovered only incidentally at the autopsy table. This may be due partly to the fact that all the cases are not recorded in the literature. Although some of these tumors may be symptomless and escape a clinical diagnosis, the majority can be diagnosed clinically and early surgical intervention may give good results.

In a brief review of the literature of the last ten years covering gastric tumors other than carcinoma, we found the majority of such cases on record in foreign literature. Individual case reports are found with an occasional multiple report. These cases consist of both benign and malignant types of tumors. Under benign such growths as leiomyoma, fibroma, neurinoma, dermoid and adenomyoma are found. The malignant group is classified as leiomyosarcoma, fibrosarcoma and lymphosarcoma.

In an extensive review of the literature on leiomyoma of the stomach by Conway,[2] in 1936, he found fifty-six authentic cases of leiomyoma and added two of his own cases. In 1933, Edward and Wright[3] in their review found thirty-eight cases of leiomyosarcoma. Since that date we found twenty-two additional cases in the literature including three of our own cases, bringing the total up to sixty.

The most recent studies made by Taylor,[4] in 1939, show 152 cases of primary lymphosarcoma which includes five of his cases. From his statistical analysis he concludes that 40 to 50 per cent of all gastric sarcomas are lymphoid in origin, and that sarcomas form 1 to 2 per cent of all gastric neoplasma.

Primary lymphosarcoma of the stomach may originate from any lymphatic tissue of that organ, such for example, as from the submucosa lymph follicles. Pack and McNeer[5] classified these into four types grossly: (1) polypoid, (2) ulcerative, (3) multinodular and (4) diffuse infiltrative; and histologically into two types: reticulum cell type and lymphocytic type.

In an analysis of all types of gastric tumors recorded at this hospital in the last ten years, excluding cases not confirmed by histological studies, we find a total of 122. Of this number 115 were carcinomas of various classifications, two benign epithelial tumors and five nonepithelial tumors. Nonepithelial tumors, therefore, show a little over 4 per cent of the total.

We are not concerned at this time with tumors originating from the mucosa of the stomach, but desire to discuss noncancerous tumors of the stomach. Two of the five cases of tumors were reported in 1935.[1] Both were operated on at that same time. It is interesting to note from a recent communication with the surgeon that both of the patients are free from localized recurrence or metastases after five years. Besides these two already recorded we would like to add three more cases of nonepithelial tumors of the stomach:

CASE REPORTS

CASE I. P. DeR, age fifty, a white, male Italian was admitted to the hospital, August 28, 1937, complaining of cough of about three months' duration, hemoptysis and weakness. With the onset of cough and hemoptysis, the patient noticed progressively increasing weakness, dyspnea and night sweats. Prior to this time he had no complaints. His appetite was always good. There was no nausea or vomiting, diarrhea or melana. He admitted occasional constipation. For three days prior to admission he noticed a marked weakness of his left arm. His past history and family history were negative.

Examination revealed a well developed, well nourished, white adult male with marked pallor and a slight greenish-yellow tinge to the skin.

liver and spleen was not palpable. No tenderness was present. There was edema of the right hand and paralysis of the right arm. Lymph
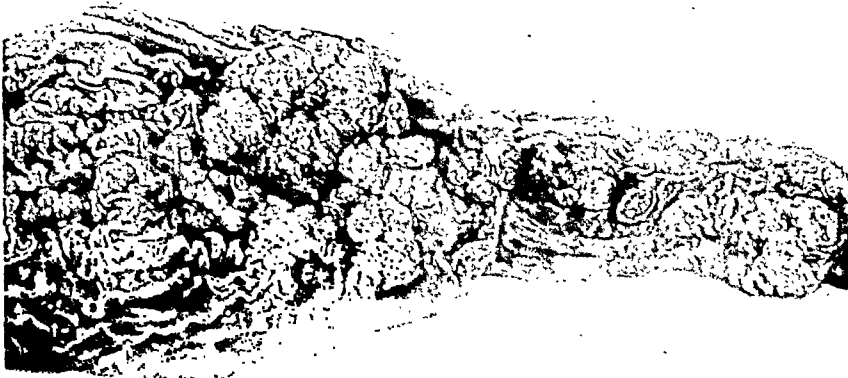
FIG. 1. Case 1. Stomach and duodenum open, showing multiple submucosal neoplasm extending down to the jejunum.
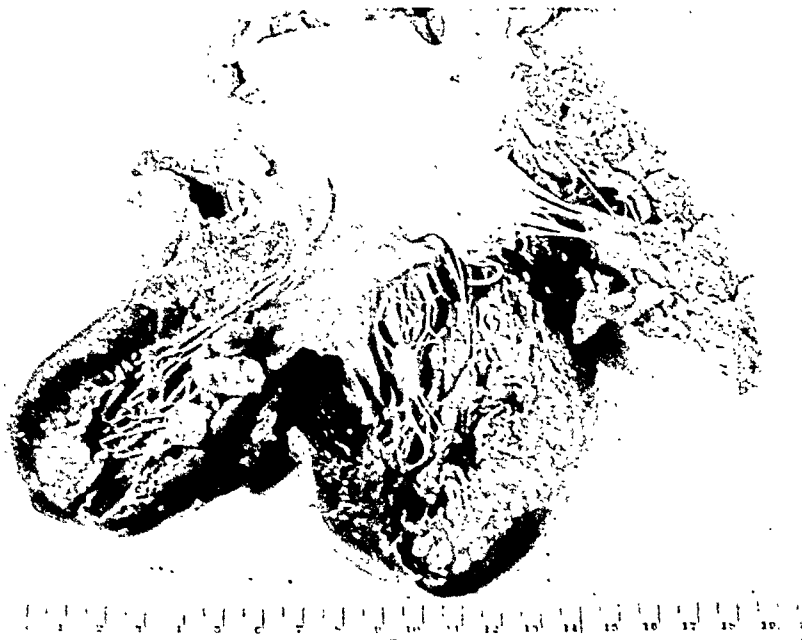
FIG. 2. Case 1. Showing extensive metastases to the heart.

He was perspiring profusely, had a moist cough, and pulse of 120, respirations 42 and temperature 103°c.

A small nodule was palpable in the left cervical region, one over the left anterior chest and in the right upper quadrant of the abdomen. His heart was enlarged to percussion with a soft systolic murmer at the apex. There was impaired resonance of both lungs posteriorly more marked on the right side; numerous moist musical râles throughout the lung fields. Breath sounds were diminished on the right side. The abdomen was soft, rounded and distended. The

nodes were palpable in the left axilla; few mesenteric nodes were palpable; also inguinal and left cervical. X-ray showed a marked increase in the size of the liver and an increased density in the middle portion of each lung, suggesting the possibility of an infiltration or of an infarction.

Laboratory findings showed hemoglobin of 21 per cent, red blood count of 1,440,000, white blood count of 21,150, polymorphonuclears 92 per cent and lymphocytes 8 per cent. Impressions: malignancy of lung, acid fast infection, blood dyscrasia with profound anemia and pos-

FIG. 3.

FIG. 4.

FIG. 5.
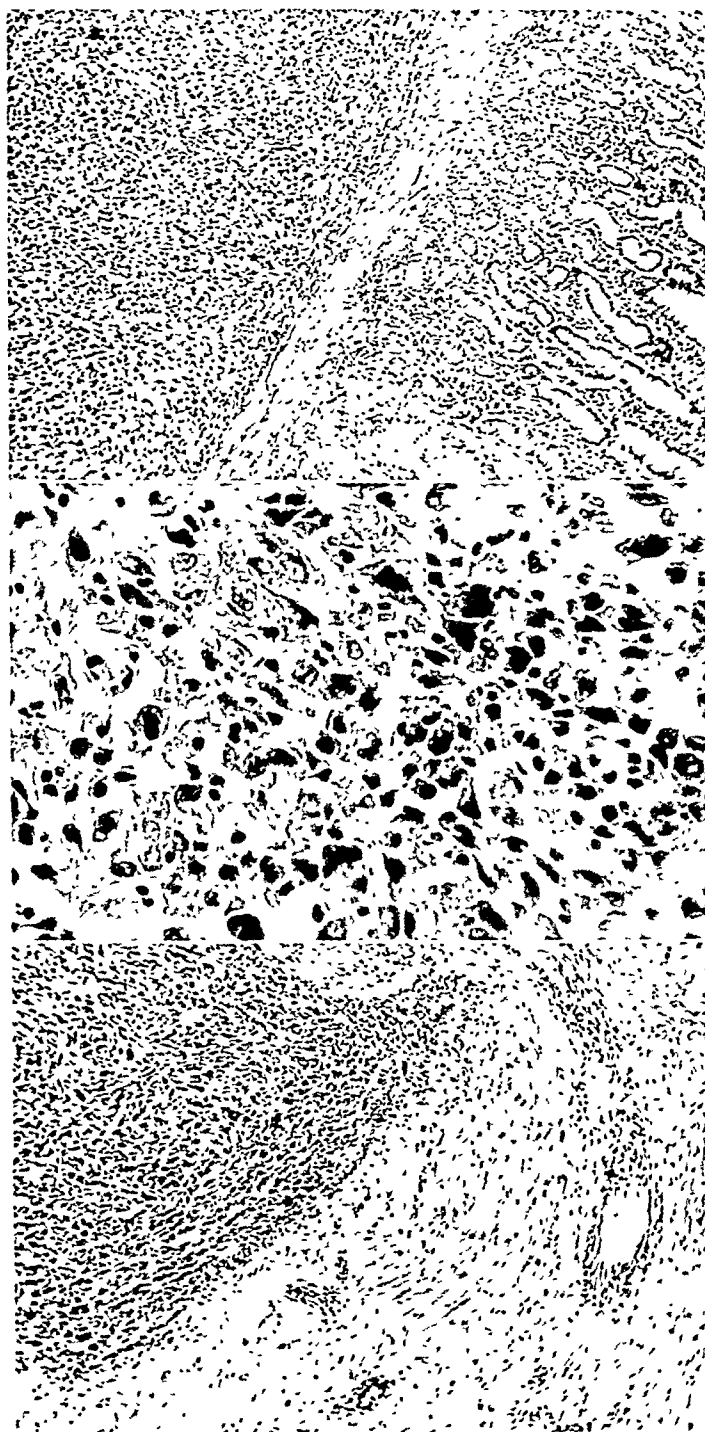
FIG. 3. Case 1. Showing circumscribed tumor separated from mucosa of the stomach by muscularis mucosa; hematoxylin and eosin stain; low power 100 ×.

FIG. 4. Highly undifferentiated cells, pleomorphic, hyperchromatic and numerous mitotic figures (leiomyosarcoma); hematoxylin and eosin stain; high power 400 ×.

FIG. 5. Case 1. Metastasis to the myocardium; low power 100 ×.

sible lues before x-ray; after x-ray the possibilities of endocarditis with infarcts and mural thrombus were added. While being prepared for

showing necrotic center and evidence of hemorrhage.

There were no gross evidences of metastases
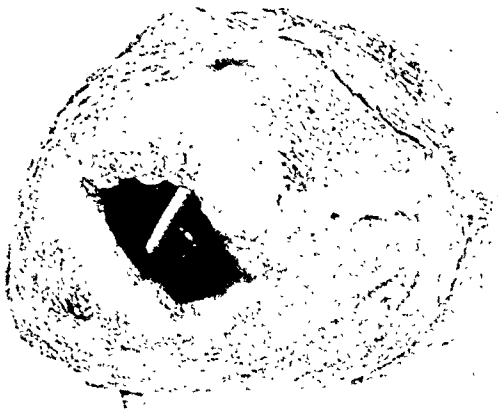
FIG. 6. Case 11. Showing the tumor and small portion of the stomach wall.
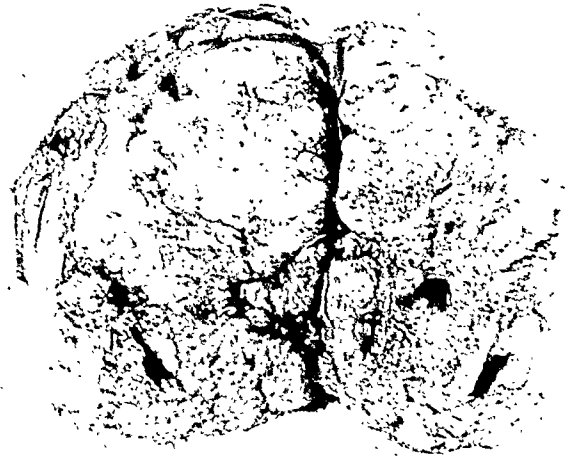
FIG. 7. Case 11. Cross section of the tumor; note the encapsulation to the tumor.

FIG. 8. Case 11. Showing the relations of the tumor to the gastric mucosa; low power 100 ×.

transfusion, the patient expired, and autopsy was performed.

The gross anatomical findings showed blood-tinged fluid in the peritoneal cavity and numerous pinkish-grey nodules on the omentum. The largest one was 2 cm. in diameter. The stomach showed multiple soft masses protruding into the lumen, located at the greater curvature extending all the way down into the duodenum. The largest tumor measured 6 by 5 by 3 cm.

to the liver, spleen, pancreas, kidneys and adrenals. The left pleural cavity showed a small amount of hemorrhagic fluid. The upper lobe of the left lung was fixed to the chest wall. Two small nodules found at the junction of the upper and lower lobes extending into the lung were soft, pinkish-grey in color and grossly resembled those found in the stomach.

The peribronchial lymph nodes were slightly enlarged. The heart was markedly enlarged and

the pericardium contained a moderate amount of blood-tinged fluid. On sectioning, the myocardium the normal musculature was found

tumor showed well defined mucosa, submucosa and muscularis mucosa. The tumor was apparently originating from the muscular layers. The

FIG. 9. Showing the tumor with well differentiated bundles of smooth muscle fibers forming whorls (leiomyoma); hematoxylin and eosin stain; high power 400 ×.
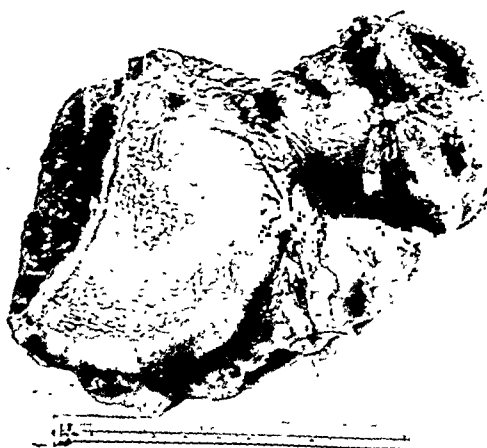
FIG. 10. Case III. Showing the resected stomach with extensive neoplasm.

FIG. 11. Case III. Stomach opened. Infiltrating type of a tumor involving all the layers of the stomach.

partially replaced by a pinkish-grey, soft tumor mass protruding into the left ventricular chamber also invading the papillary muscles and chorda tendina of the mitral valve. The right side of the heart showed similar infiltration of the septum and the anterior wall of the right ventricle. The auricles, pulmonary and aortic valves were free from metastases. Microscopical study of the sections of the stomach

cells were multiform, poorly differentiated and had hyperchromatic nuclei and numerous mitotic figures. The majority of the cells were spindle-shaped resembling that of smooth muscle cells; others were multinucleated and single nucleated giant cells.

Sections from the heart, lungs, and omentum showed identical tumor cells that were found in the original tumor of the stomach. The diag-

nosis was leiomyosarcoma of the stomach and duodenum with metastases to the heart, lung and the omentum.

enough to keep the patient awake at night. Bowels which had been regular up to six weeks before, became constipated and daily enemas

FIG. 12.
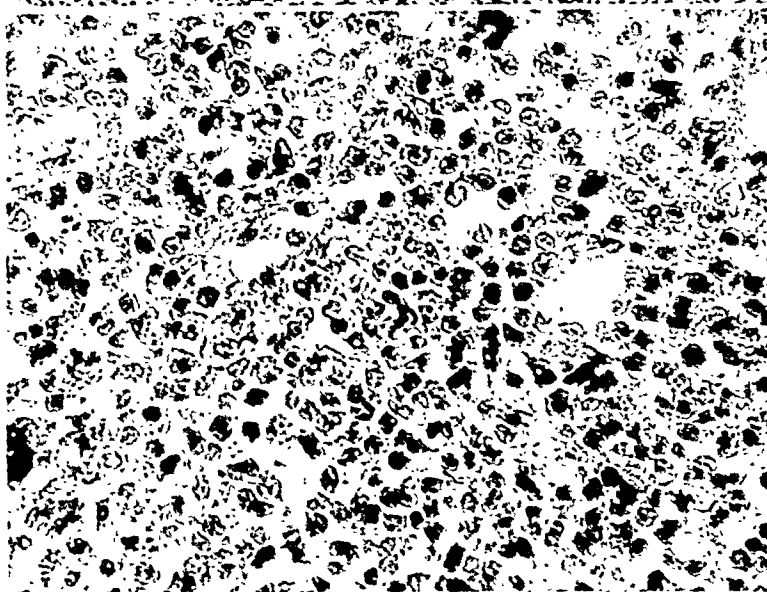
FIG. 13.

FIG. 12. Case III. Round cell type of sarcoma infiltrating the mucosa; note the glands intact; low power 100 X.

FIG. 13. Case III. Note the type of cells generally uniform, hyperchromatic nuclei and mitosis is seen (lymphosarcoma reticulum type).

CASE II.   Mrs. G. R., aged seventy, para 16, was admitted to the hospital on August 31, 1940, complaining of midabdominal cramps and burning, profuse vomiting, weakness and anorexia. These symptoms began four weeks prior to admission and on one occasion emesis contained bright red blood. The epigastric pain had no characteristic radiation and was severe

were productive of a dark black stool. The patient lost twenty pounds in six weeks and weakness became rather marked. No jaundice was noticed at any time.

The patient had attended the out-patient department since 1930 with similar complaints except for the absence of bloody vomitus and tarry stools. Physical examination at the time

was negative except for severe tenderness over the gallbladder region. The laboratory report showed hemoglobin 70 per cent; red blood count 4,100,000; white blood count 8,400; and urinalysis, Wassermann and Kahn tests were negative. Gastric analysis showed an achylia with a faint trace of blood. The gastrointestinal series and cholecystogram showed no lesion which could be a basis for symptoms. An abdominal support was prescribed for a pendulous abdomen and symptoms were relieved. Since the onset patient returned to the clinic about four to five times a year and presented various other complaints such as headache, nervousness and vertigo, none of which could be related to gastrointestinal system. There were intermittent recurrences of original complaints but these were of a mild nature. Diarrhea started about one year after her visit, alternated with constipation and at times was rather severe. For one year before the onset of present symptoms the patient felt fairly well. Other incidents in her postmedical history were tonsillectomy in 1916, thyroidectomy in 1917 and laparotomy in 1919 for some unknown reason.

Physical examination on admission showed deep tenderness over the epigastrium and to a lesser extent over left half of abdomen. No masses were palpable and peristalsis was active. Left lobe of thyroid was uniformly enlarged with no nodules present. Heart and lungs were negative. Blood pressure was 134/80. T.P.R. normal; hemoglobin 70 per cent; red blood count 4,380,000; white blood count 7,454; and urinalysis negative.

The gastrointestinal series showed a rather extensive filling defect of the middle and distal portion of stomach. X-ray diagnosis was that of a large neoplasm, probably carcinoma. The value of surgery was difficult to estimate due to extensive involvement but a laparotomy was decided upon for subtotal gasterectomy or palliative gastroenteromy. Eight days after admission during which time epigastric pain, anorexia, and severe tenderness continued, she developed a chill and ran a temperature of 101.2°c. Physical examination showed impaired breathing and x-ray showed a pneumonic process in lungs, temperature receded in three days and eleven days after pneumonitis.

The patient was operated upon. A large mass about the size of a baseball was felt within the stomach attached to the lesser curvature by a broad base causing an intussusception. Due to

sudden increase in pulse rate of subtotal gastrectomy could not be performed and instead the tumor was excised from the stomach wall and the opening closed. No metastatic nodules could be found. Blood transfusion and intravenous glucose were given during operation.

Postoperative convalescence was entirely uneventful and the patient was discharged sixteen days after operation feeling fine.

The excised tumor measured 12 by 10 by 5 cm. One surface was covered by mucous membrane, the opposite side by a serous covering well encapsulated. There was an ulcer in the center of the mucous membrane with an inverted margin measuring 3 by 1 by 2 cm. On sectioning, it was firm and solid in consistency, friable and pinkish-grey in color.

Microsections of the tumor showed a well defined gastric mucosa. The glands were lined by high columnar epithelium and goblet cells. The muscularis mucosa showed definite demarcation from the tumor mass which occupied the muscular layer of the stomach. The muscle fibers ran in all directions. The cells were well differentiated and mature in type. They were uniform in size and staining characteristics. No evidence of malignant degeneration was present. Pathological diagnosis of leiomyoma of stomach was made.

CASE III. A fifty-three year old white female was admitted to the service of Dr. H. Frankenstein, on October 2, 1939, complaining of abdominal pain for a period of six months. Most of her pain was in the epigastric area and radiated through her back. She also complained of anorexia, vomiting, constipation, black tarry stools and some dyspnea on exertion. There were no chills, fever or jaundice. She lost twenty-eight pounds in six weeks.

On examination the abdominal wall was flaccid and a mass was palpable in the right upper quadrant just below the right costal margin. It was fixed, nodular and adherent to the surrounding structures. The remainder of the physical examination was negative. T.P.R. are in normal limits.

The patient had several attacks of emesis all of which were coffee-ground in nature. The urine was negative, hemoglobin 49 per cent; red blood count 2,770,000; white blood count 6,650. The gastric contents were positive for occult blood and negative for free HCl. The Wassermann and Kahn tests were negative; blood sugar 95 and N.P.N. 29.

X-ray showed a defect at the pyloric end of the stomach. Following three transfusions a subtotal gastrectomy was performed on October 12. There were a few regional lymph nodes involved but the liver showed no metastases.

The resected portion of the stomach presented a large tumor mass of stony hardness involving the anterior surface and greater curvature of the stomach. It measured 9 by 9 by 4 cm. and on sectioning presented marked fibrosis. Near the distal portion was a papillary growth about 1.5 cm. in diameter which was markedly injected, soft and friable. Around this mass there were numerous small similar growths with ulceration. On sectioning, the mass was stony hard, gritty and showed some degeneration. Following the study of microscopic sections, the diagnosis of round cell sarcoma (lymphosarcoma) was made.

The immediate postoperative course was good. Temperature not going above 99.8°C. She received deep x-ray therapy to the gastric area on October 28, for thirty-five minutes, October 30, forty-one minutes and November 1, thirty-nine minutes. She improved and was discharged November 5, 1939.

The patient was readmitted on December 26, 1939 complaining of pernicious vomiting, weakness and pains in her back.

A gastroscopy showed the gastroenterostomy opening to be adequate. She continued to vomit persistently for days and expired on February 18, 1940. No permission was obtained for autopsy.

DISCUSSION

Myosarcomas of the stomach usually arise from the curvatures and often project into the peritoneum as solitary solid or cystic tumors and may attain an enormous size. The majority are single but occasionally they are multiple in origin as in our cases. They very seldom occur near the pylorus and obstruction is, therefore, uncommon.

Leiomyoma and leiomyosarcomas of the stomach have been divided into three types: the extragastric, the intragastric or submucosal and, thirdly, the infiltrating or mucosal variety. The extragastric is the type most frequently observed. They are generally well encapsulated, well outlined and circumscribed, giving the appearance of an innocent tumor. Metastases are not common. The mucosa is usually free from infiltrating tissue and can be easily shelled off, while in lymphomatous growths infiltration of the mucosa is fairly common. Ulceration and perforation throughout the mucosa occurs in many of the cases, causing the most common symptom—hemorrhage —with its resultant anemia. The margins of the ulcer are usually inverted in contrast to carcinomatous ulcers whose edges are everted. Various forms of degenerative changes with cyst formation frequently occur.

The histological structure of leiomyosarcoma varies: sometimes the cells are distinctly muscular in type; in other cases the predominant cell may be the large spindle variety, while in still *others* there is a mixture of both. Determination of the origin of the tumor depends upon the predominating cell type. At times this is fairly simple and definite, while at others it is doubtful because of the marked cellular anaplasia present.

In several cases on record, the tissue diagnosis was not conclusive, the opinions of various pathologists being widely divergent.

Some of the tumors were diagnosed as cellular carcinoma, but in subsequent examinations the diagnosis was changed to sarcoma. The consensus of opinion at this time is that most of the spindle cell tumors originate from the muscle layers of the stomach and that they are a well defined group resembling myosarcoma of the uterus. It is doubtful that all cases grouped as lymphosarcoma of the stomach actually originate primarily in the stomach. It is more reasonable to assume that some of these cases are simply a local manifestation of a general disease, such as Hodgkin's disease, or arise *secondarily* from a distant primary focus.

SUMMARY

1. Of all types of primary gastric tumors diagnosed histopathologically in this hospital within a period of ten years, there was a

total of 122. Five were nonepithelial tumors or a little over 4 per cent.

2. Three out of five are still living and well after surgical intervention, two for a five-year period and in one, over a year has elapsed since operation.

3. Two patients are dead, one with multiple leiomyosarcoma of the stomach and duodenum with metastasis to heart, lung and omentum. The second patient died of recurrent reticulum cell sarcoma of the stomach. No postmortem examination was available, therefore, no account of the extent of metastasis can be given.

4. In leiomyosarcoma of the stomach, when diagnosed early and before metastasis, total resection of the tumor with partial gastrectomy generally will give very good results.

5. Nonepithelial tumors can occasionally be diagnosed grossly but final diagnosis must rest on microscopical study of the cellular elements. At times even microscopical studies are not conclusive especially in borderline cases of cellular leiomyoma and sarcoma.

6. Surgery in lymphosarcomas usually is not as encouraging as in cases of leiomyosarcoma.

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PEPTIC ULCER AND GASTRODUODENAL FISTULAE*

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FISTULAE due to peptic ulceration are not uncommon. Most of them develop as complicating sequelae to surgical intervention in the treatment of chronic peptic ulcers. They are represented by the gastrojejunal or gastrojejunocolic fistulae. Corresponding to the increase of gastric surgery in the treatment of peptic ulcer, their number has increased manifold in the past three decades.

In contrast to the above, the occurrence of spontaneous gastric fistulae, on the basis of a peptic ulcer, seems to be rather uncommon. The literature contains only few references to fistulae between the stomach and other contiguous abdominal organs. Thus one finds only *isolated* reports of peptic ulcer causing fistulae into (a) the transverse colon, (b) the duodenum, (c) the ileum, (d) the jejunum, (e) the gallbladder, (f) the common bile duct, (g) the pancreatic duct, (h) the portal vein, (i) the renal pelvis, and (j) the spleen. A few instances of fistulae between the stomach and nonabdominal organs, as the heart (left ventricle), pericardium, lungs, pleural space, and skin, are also recorded.[1]

A perusal of the literature reveals that only very few cases of true gastroduodenal fistulae have been reported. Although met only infrequently, the awareness of such a condition is of obvious importance to those engaged in gastrointestinal practice. The following two cases are, therefore, reported:

CASE 1. J. C., male, aged forty-six, entered the medical services of the Cook County Hospital, complaining of intermittant abdominal pain of four years' duration, and a loss of 20 pounds during the previous three months. He was quite well until about one year before when he first developed a pain in the left upper quadrant which radiated to the back. This distress occurred within three hours after meals, was quite sharp and was relieved by any kind of food and by vomiting. Alkalis were not taken. The pain would cease spontaneously within one-half to one hour, but the evening pain usually persisted throughout the night, until he ate breakfast. There was no periodicity to the pain. In the past year the patient had vomited only four times and this had occurred at the height of the pain. No constipation or diarrhea has been associated with the condition. Lately anorexia, weakness and loss of weight became apparent. There were no other pertinent symptoms. His past and family history were irrelevant.

The physical examination revealed a fairly well developed and fairly nourished individual, who was apparently in distress. His temperature and respirations were within normal. The pulse was 96. The blood pressure, 120 systolic over 78 diastolic. Increasing breath sounds and a suggestive pleural friction were noted over the right pulmonary base posteriorly. The heart findings were within normal limits. The abdomen was slightly distended. There was a fullness in the epigastrium which seemed to move on respiration. Tenderness and resistance to palpation were present over that fullness. The liver was not felt. Other findings were essentially negative.

The laboratory examination disclosed a free acidity of 60 and 45, and a total of 80 and 60 degrees, respectively. There was no lactic acid. The stool showed no chemical blood. The Wassermann test was reported negative.

In view of the above history and findings, the diagnosis of a peptic ulcer was made, although a malignant growth of the stomach was strongly considered. The patient felt well on a modified Sippy regimen. An x-ray taken three days after entrance was reported as follows: "The pars media of the stomach act as a re-

tention pocket holding the barium as long as 48 hours. The pyloric portion and duodenal bulb seem to open from the lesser curvature

FIG. 1. Case 1. X-ray showing tobacco pouch-like stomach with large gastric ulcer continuous with duodenum. A, gastric ulcer; B, duodenum.

of the stomach high up as if the patient may have had a penetrating ulcer on the lesser curvature of the stomach which had perforated into the duodenum. The large pocket fills first and then the barium goes through the pylorus. There is an incisura opposite the duodenal bulb and there is a very definite fleck of barium, after 48 hours' examination." (Fig. 1.)

Because of the unusual findings, the patient was transferred to a surgical ward for an exploratory operation, which was performed by Dr. K. A. Meyer. A large inflammatory mass was found along the lesser curvature of the stomach, which extended toward the antrum and first portion of the duodenum. A crater was palpated on the inner surface of the mass, which seemed to continue as a fistulous tract into the duodenum The operation was terminated with a posterior gastroenterostomy.

The patient made an uneventful recovery and continued symptom-free on Sippy management. An x-ray taken four weeks after the operation showed: "Small retention. Gastroenterostomy functioning well. Moderate amount of barium goes through the region of the perforated ulcer." After discharge from the hospital, the patient was referred to the

Gastrointestinal Clinic. There he reported at various intervals, always feeling fine and showing a gain in weight while on a Sippy regimen.

FIG. 2. Case 11. X-ray of stomach showing large penetrating ulcer; fistulous communication not seen.

CASE 11. R. G., a white, fifty-four year old male, entered the medical services of the Cook County Hospital, complaining of abdominal pain and loss of weight, of about two months' duration. He was apparently well until six months previously, when he first noted a postprandial fullness associated at times with abdominal distress. This continued for about three months, when he developed additional symptoms of anorexia and weak spells. This fullness was best relieved by induced emesis. About two months before, he experienced for the first time a lower abdominal pain which would occur two to three hours after meals. This pain, steady and burning, was relieved by vomiting, water and alkali, and aggravated by acidic foods. In the past few days, he had emeased a "coffee ground" material, and noted that his stools were black. He has lost weight progressively since the onset of the first symptoms, (a total of about 20 pounds in six months).

The only pertinent finding in his past history was the ancient occurrence of a "blind abscess" in the right lower portion of his abdomen

FIG. 3. Photograph of postmortem specimen of stomach showing large penetrating ulcer (A) and the stoma of the spontaneous perforation of the duodenum (fourth portion) (B).

FIG. 4. Microphotograph of section from raised edge of the large gastric ulcer showing (A) floor of ulcer and (B) overhanging edge. No malignant changes noted.

which drained spontaneously through the rectum. There was no history suggestive of previous gastrointestinal disturbance. The patient smoked and drank moderately. The family history was irrelevant.

The physical examination revealed a well developed but poorly nourished individual, not acutely ill. His temperature was 98.4°F., pulse, 56, and blood pressure 144 systolic over 94 diastolic. The chest was phthisical with deep supra- and infraclavicular fossae. There was a bronchial type of breathing in both apical areas, especially in the right where a few clicking rales were heard. The heart was slightly enlarged and the tones were distant. The peripheral vessels were sclerotic. The abdomen was scaphoid and slightly rigid in the upper

quadrants. The liver and spleen were not enlarged. The extremities and the reflexes were within normal.

the stomach was considered the most probable diagnosis, although the possibility of a peptic ulcer was also entertained. The patient was put
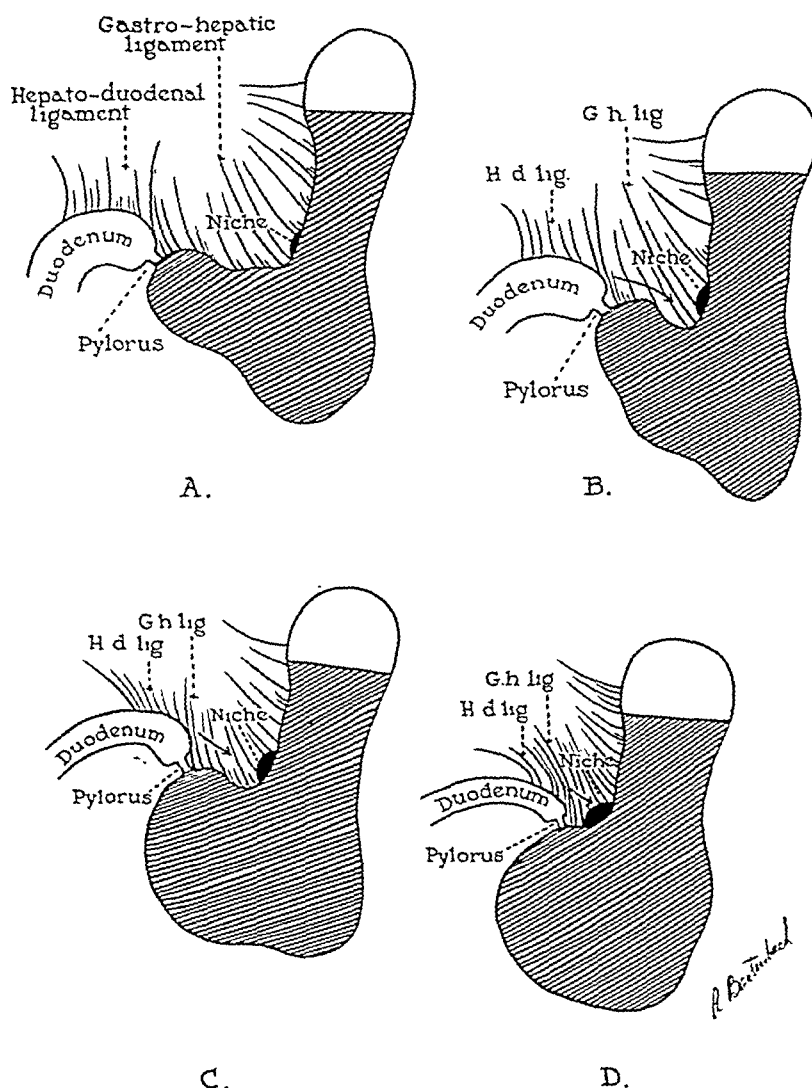
FIG. 5. Schematic visualization of the shrinking of the lesser curvature with the subsequent "snail-like" rolling in of the stomach. The arrows on B-D point to the shrunken area.

The laboratory workup disclosed persistent chemical blood in the stool, a free acidity of 40 degrees, a total of 58 degrees and no lactic acid. The hemoglobin was 80 per cent (Tall-quist); the red blood count 5,150,000 and the white blood count, 15,500. (The comparatively high blood count was probably due to dehydration with hemoconcentration.) The urine examination was negative. An x-ray of the stomach showed a large constant niche on the lesser curvature of the pars media of the stomach. (Fig. 2.)

Because of the relatively short history, the patient's age and his cachexia, a carcinoma of

on sedatives, antispasmodics and the "cream-alin drip" was instituted. In spite of careful and intensive management, including also intravenous fluids, the patient continued to go downhill, and expired five days after entrance to the hospital, shortly after a massive gastric hemorrhage.

At necropsy the main pathology was found in the abdominal cavity, which contained a small amount of a serosanguinous fluid. Several of the intestinal loops were adherent to each other by focal fibrous adhesions, and dense adhesions were formed between the posterior wall of the stomach and the neighboring viscera.

especially the distal third of the duodenum. The stomach and the intestines were markedly distended and contained a large amount of dark red liquid and coagulated blood. The mucosa of the stomach was injected, studded with many dark red pinpoint hemorrhagic areas, and was covered by a bloody mucoid material. The folds and rugae were fairly distinct. About 4½ cm. proximal to the pylorus and along the posterior aspect of the lesser curvature of the stomach was a large crater-like defect, 4 mm. in depth and 6 cm. in diameter, with moderately indurated and undermined edges. The base was grayish tan and 1 cm. from the edge proximal to the pylorus were three open-mouthed vessels up to 2 mm. in size, which were filled with loose, clotted blood. Near the center of the crater was a 3½ cm. defect through the muscularis and serosa of the stomach, which opened directly into the fourth portion of the duodenum, forming a natural gastroenterostomy stoma which was functioning both ways. The margin of the ulcer nearest the pylorus for a distance of 2 mm. was raised to a height of about 4 mm. and was about 4 mm. wide. (Fig. 3.) This area was slightly firmer than the rest of the rolled margin. Five mm. distal to the large defect of the mucosa was a 15 by 10 mm. defect, which was very superficial. The duodenum and first portion of the jejunum were congested and dark purple red. The pancreas was slightly adherent to the stomach near the gastroduodenostomy. Its consistency was slightly increased and it weighed 50 Gms. On sectioning, it was light tan and uniformly lobulated. There was also a Meckel's diverticulum which was 4 cm. in length.

There were no other pertinent findings in either the abdominal or chest cavities.

Microscopic section of the stomach through the ulcer showed the floor to consist of dense sclerosed connective tissue which had completely substituted the muscularis propria. On the surface, the connective tissue gradually passed over into a layer of fibrinoid necrosis, of cellular granulation tissue and of callous tissue. At the edge, the necrotic zone extended beyond the reflection into the proximal part of the overhanging portion The muscularis also extended into the overhanging portion. There were round cell infiltrations about some of the smaller vessels of the submucosa. The adjacent gastric mucosa was composed of

tubular and slightly tortuous glands, between which were found several plasma cells and some polymorphonuclear leukocytes. There was no evidence of malignancy. (Fig. 4.)

SUMMARY AND CONCLUSIONS

Two cases of noncarcinomatous, true gastroduodenal fistulae are reported and their pathogenesis discussed.

Even though rare, such fistulae occur sufficiently often, as to make diagnosis difficult.

The awareness of such a condition is not only of diagnostic interest but also of practical importance to the surgeon, who otherwise when confronted with it at a laparotomy might easily diagnose it as a malignant, nonoperable mass.

To the internist and roentgenologist, the knowledge of such an affection may be of diagnostic aid in cases which present a peculiar abnormality in the gastroduodenal region.

Since there is no known way in which such a condition may be diagnosed clinically, the hope for a correct diagnosis rests unquestionably on the x-ray examination. In some cases, however, the last decision may have to be made by the surgeon.

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PHARYNGOESOPHAGEAL DIVERTICULUM

REPORT OF TWO PATIENTS TREATED SUCCESSFULLY BY A ONE-STAGE PROCEDURE

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MANY patients with pharyngoeso-phageal diverticula have been operated upon since the first successful case reported by Von Bergmann in 1892. While the condition is a relatively uncommon one, there have been in recent years many comprehensive reports in this country by Judd, Lahey, and Babcock and by Moynihan, Billet, Diez, Gerlings and Godard abroad. Herniations of the mucosa and submucosa represent a type of pulsion diverticulum. They differ from the traction type in that the latter contains all layers of the wall including the muscular layer. The traction type is more prevalent at the root of the lung where scar tissue from peri-bronchial lymph nodes exerts a pull on the coats of the esophagus. These traction diverticula rarely require surgical intervention. The pulsion type is usually found at the pharyngoesophageal junction posteriorly, where there is frequently a congenital weakness of the diagonal fibers of the inferior constrictor muscle of the pharynx as it meets the circular muscle of the esophagus. Most of these diverticula invariably present themselves toward the left side of the neck due to the proximity of the esophagus to that side at that level.

Pulsion diverticula may be relatively small but at times they reach considerable size. As their size increases, they gravitate along the vertebrae into the upper mediastinum between the pretracheal and prevertebral layers of fascia. They occur about four times more frequently in men than in women; moreover, they do not seem to attain similar magnitude in women as in men. They are rarely ever seen before the age of fifty although the history often suggests that they have been present for a considerable length of time.

Usually the patient does not seek surgical relief until a great deal of difficulty has been experienced in swallowing. Other symptoms as regurgitation of food, gurgling noises, or even choking spells may be prominent. The larger diverticula usually lead to inanition and dehydration since the enlarging sac encroaches upon the normal lumen of the esophagus causing distortion of the latter passage. This fact can be appreciated by those who have examined these individuals endoscopically in whom it becomes almost impossible to follow the esophageal lumen even under direct vision. We call attention here to the dangers of bougienage for diagnostic purposes and reserve this procedure for those cases which require it as a postoperative maneuver. Even here, perforation and resultant mediastinitis have been reported. We believe it advisable to have the patient swallow one end of a long silk thread some days before esophagoscopy. This string also facilitates introduction of a stomach tube for feeding purposes pre- or postoperatively.

There are many advocates of a routine two-stage operation but we are impressed with a like number of one-stage operators who have never had mediastinitis as a complication. After reviewing the results of

those with greatest experience, we have concurred with the opinions of Judd and Harrington who reserve the two-stage

over the multiple-stage operation. First, hospitalization is shorter; second, recurrence and fistula formation are rare. Better

FIG. 1. An oblique view of the partially filled diverticulum.

FIG. 2. Lateral view of the diverticulum. Note compression of the esophagus.

procedure for those cases: (1) in which diverticula are large, (2) in which considerable inflammatory reaction is found at operation on exposing the sac, (3) in which the patient does not represent a good surgical risk, and (4) in which the sac extends into the mediastinum.

In the two-stage procedure the sac is dissected from its bed and is brought up to the skin and sutured to the sternomastoid muscle as a first stage. About a week or ten days later when the tissues of the neck have become sealed off and ligation of the neck of the sac and its removal are carried out, there is very little danger from cellulitis and mediastinitis. However, in certain instances in which operation upon the neck has been carried out before, the planes of the neck are already sealed off by scar tissue; consequently, this danger is eliminated.

In the individual in whom the diverticulum is small and the condition good, the operation can be carried out safely in a one-stage procedure. This has many advantages

visualization of the structures about the neck of the sac is provided when there is no scar from a previous stage. This permits a closer amputation of the sac and a better closure of the stump. Third, there is less danger of injury to the recurrent laryngeal nerve. Fourth, secondary bougienage is seldom necessary due to minimal distortion and spasm of the pharynx produced. Lastly, the so-called choking spells from trapping of air in a distorted anchored sac of a two-stage operation are eliminated. In cases in which fistulae have occurred following either procedure, these have usually closed spontaneously without difficulty.

Cervical block anesthesia is preferred, for the patient is able to swallow at all times; and if any fluid should be expressed from the sac, it would not be likely to get into the trachea. Cases of pulmonary abscess have been reported in which general anesthesia was used. Moreover, patients are always instructed to empty the sac before going to the operating room.

The operation consists of an incision about four inches long, anterior to, but parallel with the sternomastoid muscle.

In the two cases reported, the hospital time was materially cut down, and the patients made uneventful recoveries. There

FIG. 3. Lateral view of the filled diverticulum.

FIG. 4. Anterioposterior view of the diverticulum.

Dissection is carried down to the omohyoid muscle; this is divided. The carotid sheath is retracted laterally and the thyroid gland medially. The diverticulum will be found coming off from the posterior wall of the pharynx and can easily be identified by its lighter color; ordinarily there is a small plexus of veins over it. Getting the patient to talk or blow will also facilitate in locating the sac. As little circulation as possible is interfered with because of the inadequate blood supply to the structures. After the sac is freed up it is brought out through the upper angle of the incision, if it is of sufficient length; if not, it is stitched to the structures of the neck and can later be identified by leaving a silk thread sutured to the sac, if there is to be a two-stage procedure. If it is to be removed in one stage, the neck of the sac is ligated and then removed, a second row of inverting Lembert sutures being applied to the stump.

was a slight drainage of liquid food particles through the incision for a few days after the nasal tube was removed, which was done on the sixth postoperative day. It is advisable to leave the silk string down the esophagus into the stomach in case a change of nasal tube has to be done at any time, or if esophageal dilatations become necessary. The patient received nourishment through the nasal tube for the first week after the operation. By this procedure, tension on the esophagus is kept as slight as possible and healing proceeds rather rapidly.

Since so many of these patients are in the older group, we feel that it is advisable to let them get up on the day following operation. This will allow them to take care of themselves, particularly in regard to bladder elimination. The risk of the operation is very low when this plan is carried out. Following the operation the patient is able

to swallow normally, and usually begins almost immediately to put on weight.

CASE I. Male, age fifty-five, had had trouble in swallowing for four or five years. He had been operated upon three times before, but recurrence followed promptly after each operation. On September 12, 1937, the patient was reoperated upon. The sac was found at its usual location. It was completely dissected and removed. The opening in the esophagus was closed by an inner row of silk. There was some drainage from the esophagus a few days after the operation but the fistula promptly closed. Since that time the patient has gained weight, has been perfectly well, without any difficulty in swallowing.

CASE II. Female, age fifty-one, had had trouble in swallowing for three or four years. X-ray revealed pharyngoesophageal diverticulum. On June 17, 1939, the diverticulum was excised by a one-stage procedure. There was a slight liquid drainage from the esophagus about one week after operation. The patient had an uneventful convalescence. She has gained weight and has had no further difficulty with swallowing. Esophagoscopic examination reveals no stricture and there is no evidence of remaining diverticulum opening.

SUMMARY

We have presented two cases in which the one-stage procedure has been used in the treatment of pharyngoesophageal diverticulum. If the patient is in good condition and the sac is not too large, we believe that this procedure can be carried out. If there is any doubt as to the one- or two-stage procedure, we believe that the two-stage procedure should be used because there is less danger of mediastinal infection.

The ultimate result should be obtained whether the one- or two-stage procedure is used. The one-stage procedure minimizes the amount of time, but time should never be considered if there is any question as to the safety of the patient.

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MERALGIA PARESTHETICA*

REPORT OF FIVE CASES

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MERALGIA paresthetica was first described in 1895 by Bernhardt. It was named the same year by Roth, from "meros" meaning thigh and "algos" meaning pain. The condition consists of a painful paresthesia of the anterolateral aspect of the thigh from the upper portion of the thigh to the knee, as outlined by the distribution of the lateral femoral cutaneous nerve. It is a relatively common condition and numerous authors have written on the subject. In spite of this, it is a condition which many physicians and surgeons still fail to recognize and treat properly. The orthopedist is not infrequently confronted with the condition.

The lateral femoral cutaneous nerve arises from the second and third lumbar posterior nerve roots and is primarily a sensory nerve, but Reichert[12] has shown that in addition to its somatic fibers, it also includes efferent sympathetic fibers carrying vasomotor, pilomotor and sudomotor impulses, and afferent sympathetic fibers carrying pain impulses. By anatomical dissections, Stookey[15] demonstrated an angulation of the nerve as it emerged from the pelvis just medial to the anterior superior iliac spine below Poupart's ligament. He found that it might pass superficial to, through or deep to the origin of the sartorius muscle, and that in some cases the never angulates more sharply by passing over a small bony ridge just below the anterior superior iliac spine. This angulation of the nerve is increased by extension and decreased by flexion of the thigh on the trunk, which explains why these patients usually have more pain when standing in the erect position.

As Bergsma[3] pointed out, meralgia paresthetica may be due to an irritation or degeneration of the nerve in its course through the thigh, or it may be simply a symptom complex which is part of a more widespread disease process involving other nerves in addition to the lateral femoral cutaneous nerve. The latter condition may be present in certain lesions of the spinal cord, the second and third lumbar vertebrae, and any intra-abdominal or intra-pelvic lesions which cause pressure on the nerve during its course through the abdomen or pelvis. When a peripheral irritation or degeneration of the nerve is present, it is usually due to trauma. This trauma may be sudden and severe, as by a sharp blow or fall on the anterolateral aspect of the upper thigh region, or it may be the result of wearing a corset, brace, truss or belt which causes pressure. Cases have been recorded which followed occupational trauma such as constant leaning against a bench. In addition to trauma as an etiological factor, toxic, infectious and metabolic disturbances have been described by some observers.

A patient afflicted with meralgia paresthetica usually first notices a numbness and paresthesia of the area supplied by the lateral femoral cutaneous nerve. It is ordinarily intermittent in character and tends to become more annoying as time goes on, until finally it may become a moderate or severe burning type of pain which is ordinarily made worse by standing or walking. On examination, a tender point may be found medial to and below the anterior superior iliac spine where the nerve becomes superficial. Hypesthesia or hyperesthesia to touch, pin-prick, and

temperature are found over the skin area supplied by the nerve; anesthesia has been noted in a few cases by some authors. The

concentrically arranged deposits of connective tissue of a hyaline nature arising from growth of the endoneurium. Bailey[8] noted
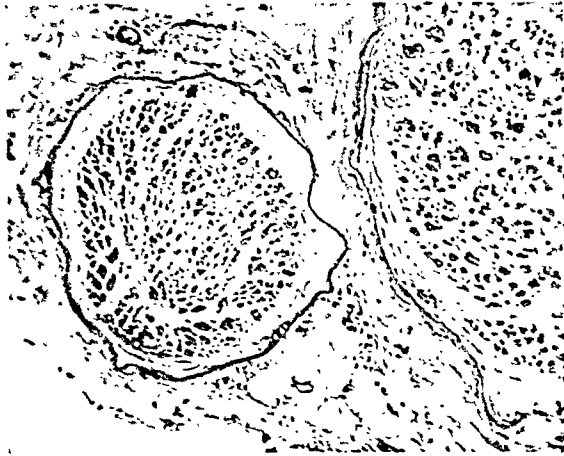
FIG. 1. Case v. Section of right lateral femoral cutaneous nerve. Note shrinkage and separation of nerve fibers. Axis cylinders are not discernible in places; hematoxylin and eosin stain. × 125.
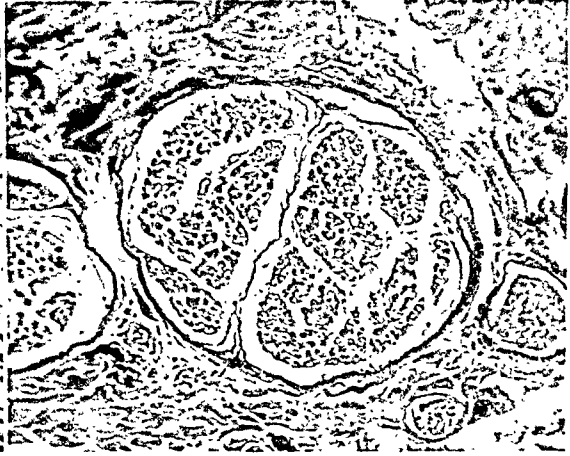
FIG. 2. Section of portion of normal nerve trunk (sciatic nerve) for comparison with Figure 1; hematoxylin and eosin stain. × 125.

condition is usually chronic, extending over a period of years.

Conservative treatment in the form of physical therapy and symptomatic medication may fail to give relief. Any offending corsets or braces should be adjusted to relieve pressure on the nerve, and any infectious, toxic or metabolic disturbances should be dealt with adequately. Intraspinal, vertebral, intra-abdominal or intrapelvic lesions should be ruled out or treated if present. If the condition is due to irritation or degeneration of the peripheral portion of the nerve, the most effective method of treatment consists in resection of a portion of the nerve in the upper thigh region. This procedure is recommended only when objective sensory changes are present. It is not advised when only a neuralgia with subjective symptoms alone is present, and should be done only when a thorough course of conservative treatment has failed to relieve symptoms.

At operation, Warda[8] noted a gross enlargement of the nerve trunk. Preti[8] observed ten cystic nodules on the nerve, while Chipault and Bellat[8] found a nerve full of varices. Haenel[1] described an extensive degeneration of the nerve upon microscopic examination with nodular and

a microscopic fibrous thickening of the nerve sheath with degenerative changes in many of the fibers. Sougues and Andre-Thomas[8] found the nerve to be grossly and microscopically normal.

CASE REPORTS

Five patients with pain and demonstrable sensory changes involving the area supplied by the lateral femoral cutaneous nerve have been treated at the New York Orthopaedic Dispensary and Hospital by resection of a segment of the nerve in the upper thigh region beyond its emergence from the pelvis under Poupart's ligament. Twenty-one others responded to conservative therapy and were not treated surgically. They are not included in this report.

Case 1. G. A. H., female, aged thirty-two, had a pelvic laparotomy done in March, 1938, under spinal anesthesia for a retroverted uterus. Upon resuming walking several weeks later, she first noted a numbness, tingling and burning pain over the anterolateral aspect of the right thigh which became more constant and annoying as time went on. Examination revealed hypesthesia to pin-prick over the distribution of the right, lateral, femoral cutaneous nerve. On July 25, 1938, (four months after onset of

symptoms), under general anesthesia, the nerve was exposed in the upper thigh and one and one-quarter inches of it were resected. An Ober fasciotomy was also done because of a concurrent sciatic neuralgia. The section of nerve removed was grossly and microscopically normal. The patient experienced immediate relief of pain. Following operation, she noted a feeling of "deadness" over the involved skin area which disappeared after two months; a sensation of numbness persisted for an additional four months. On May 18, 1940, twenty-one months after operation, examination disclosed hypesthesia to pin-prick over the anterolateral aspect of the right thigh. Complete relief of pain had resulted.

CASE II. M. S. K., female, aged twenty-nine, noted a gradual onset of numbness and paresthesia over the anterolateral aspect of the right thigh in 1924. No trauma was recalled. Numbness and tingling gradually became more severe and were replaced by burning pain which occurred several times monthly, lasting two or three days on each occasion. Symptoms were accentuated by prolonged standing and physical exertion. An area of hypesthesia was present over the distribution of the involved nerve. Pain was entirely relieved by 1 per cent novocaine injection of the nerve trunk just below and medial to the anterior superior iliac spine at its point of passage through the fascia lata. On October 29, 1938, (fourteen years after onset of symptoms), under local anesthesia, the nerve was exposed in the upper thigh and one inch of it excised. Grossly and microscopically the nerve was normal. A feeling of "heaviness" and "deadness" over the involved area disappeared two and one-half months after operation, giving way to a sensation of numbness which persisted for an additional three and one-half months. Pain was immediately relieved. On May 20, 1940, nineteen months after operation, examination disclosed hypesthesia over the anterolateral aspect of the right thigh. There had been no recurrence of pain.

CASE III. E. L., female, aged nineteen, was born with a congenital dislocation of both hips. Shelf stabilization of the left hip was done in 1935, and a similar procedure was done for the right hip in 1936. Onset of intermittent numbness and pain over the anterolateral aspect of the left thigh was first noticed in December, 1938. This was experienced when walking and

was relieved by sitting or lying down. The patient found it necessary to rest after walking two city blocks. Examination revealed hypesthesia over the distribution of the involved nerve. Pain was relieved by 1 per cent novocaine injection of the nerve. On May 29, 1939, (six months after onset of symptoms), under general anesthesia, the nerve was exposed in the upper thigh and one inch of it was excised. The nerve was grossly and microscopically normal. The patient was immediately relieved of her thigh pain. A sensation of numbness was experienced for several months after operation. On May 8, 1940, twelve months after operation, examination revealed hypesthesia over the involved area. No pain was experienced about the anterolateral aspect of the left thigh.

CASE IV. G. B. H., female, aged twenty-five, was struck while crossing the street on May 15, 1939, on the upper and outer aspect of the left thigh by an automobile. Following the accident, she complained of numbness and aching pain over the distribution of the involved nerve. The pain was made worse by standing and was relieved by flexion of the thigh on the trunk. Hypesthesia was present over the anterolateral aspect of the left thigh. On July 19, 1939, (two months after onset of symptoms), under local anesthesia, the nerve was isolated in the upper thigh and one inch of it was resected. The proximal end was injected with 95 per cent alcohol. The nerve was grossly and microscopically normal. Immediate relief of pain followed operation. A feeling of "stiffness" of the involved region disappeared three months after resection of the nerve. Four months after operation, the patient received a second degree burn of the hypesthetic lateral aspect of the left thigh by leaning against a stove. The burned area, three-quarters inch by one-half inch in size, healed normally. On May 22, 1940, ten months after operation, examination disclosed hypesthesia of the area supplied by the left lateral femoral cutaneous nerve. No pain was experienced in this region.

CASE V. P. W., male, aged fifty-one, experienced a gradual onset of numbness and tingling along the anterolateral aspect of the right thigh from the trochanteric region to just above the knee. It gradually became more annoying and painful. It ached constantly when he was standing and was relieved by sitting or lying down. His occupation (elevator operator) necessitated his standing continuously for long

periods of time. No trauma was recalled. Hypesthesia was present over the distribution of the right, lateral, femoral cutaneous nerve. On November 15, 1939, (three and one-half months after onset of symptoms), the right, lateral, femoral cutaneous nerve was isolated, under general anesthesia. A one-half inch section of the nerve was excised, and the proximal cut end was injected with 95 per cent alcohol. Immediate relief of pain was experienced. The nerve had appeared normal grossly but was markedly degenerated microscopically. This patient had consumed varying amounts of alcohol for a long period of time. A sensation of "deadness" of the anterolateral aspect of the right thigh persisted for two months after operation. On May 24, 1940, six months following nerve resection, slight numbness was still experienced, and hypesthesia to pin-prick was present over the lower two-thirds of the involved area. Pain was absent. The patient was standing eight hours a day.

DISCUSSION

Most authors[1,11] state that meralgia paresthetica is more common in males who are ordinarily obese, and in the fourth or fifth decades of life. Four of these cases herewith reported were females. None of them was obese, and their ages at operation were nineteen, twenty-five, twenty-nine and thirty-two years, respectively. The single male patient was fifty-one years of age and was not obese. There was a history of trauma preceding the onset of symptoms in three patients. All five noted an accentuation of symptoms when standing and walking. The condition was unilateral in each instance. Conservative treatment, in the form of heat and massage, proved to be of no value in each case. No gross or microscopic abnormality was found in the resected nerve segment in four of these cases. The fifth patient, who gave a history of chronic alcoholism, revealed no apparent gross pathology of the nerve but microscopically marked degeneration was seen. The axis cylinders could not be identified and the nerve fibers were reduced to nucleated neurolemma cells. The nerve fibers were shrunken and separated with

considerable interstitial edema. The Masson-Foot stain revealed only six myelin sheaths in the entire section. The Loyez myelin sheath stain showed myelin to be absent except for a few nerve fibers where the pattern was atypical.

After operation patients should be warned of the danger of burning or otherwise injuring the anesthetic area over the anterolateral aspect of the thigh for a period of six months. Two or three months after operation sensation begins to return as a result of "overlap" from adjacent sensory nerves, and the anesthetic area becomes an area of hypesthesia.

SUMMARY AND CONCLUSIONS

Resection of a segment of the lateral femoral cutaneous nerve in the upper thigh as it pierces the fascia lata to become superficial, is the simplest and most satisfactory way to treat meralgia paresthetica which has proved resistant to conservative therapy. It should be done only when objective signs of peripheral nerve irritation or degeneration (hypesthesia or hyperesthesia over involved skin area, or tenderness to pressure over nerve at point where it becomes superficial) are present. Novocaine injection of the nerve trunk in the upper thigh, with resultant relief of pain, is a helpful diagnostic aid. Operation can be done under local anesthesia and segments of both the anterior and posterior branches should be resected. Absolute alcohol can be injected into the cut nerve ends to prevent neuroma formation. A feeling of "stiffness" or "deadness" of the anterolateral aspect of the thigh is complained of after operation, but disappears after two or three months as "overlap" from adjacent sensory nerves occurs. A sensation of numbness of the involved area persists for about six months following operation.

Meralgia paresthetica is in all probability due to an irritation or degeneration of the peripheral portion of the lateral, femoral cutaneous nerve. Microscopic examination of nerve segments removed in the five cases

herewith reported, as well as in those cases reported by other observers[1,8] in the past, failed to show any evidence of inflammation.

Five patients have been treated at the New York Orthopaedic Dispensary and Hospital by resection of a segment of the nerve in the upper thigh. They have been examined six, ten, twelve, nineteen and twenty-one months, respectively, following operation. Pain has been completely relieved in each case. Prior to operation, each of the five cases presented demonstrable sensory changes in addition to pain over the area supplied by the lateral femoral cutaneous nerve.

Operation is not advised in those cases presenting solely a peripheral neuralgia, as it is believed that the great majority of the latter are relieved by conservative treatment.

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INCIDENTAL INTRA-ABDOMINAL HERNIA REPAIR

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SINCE approximately 11.7 per cent of laborers (railroad employees)[1] as well as 2 per cent of women and 6 per cent of men,[2] totalling about 4,000,-000 people in this country,[3] are estimated to have hernias, patients requiring an abdominal operation may also have an inguinal or femoral hernia. LaRoque[4] found abdominal hernia in 4 per cent of nearly 2,000 patients operated on for appendicitis and in 3 per cent of 1,500 to 2,000 women operated on for pelvic disease.

Repair of an inguinal or femoral hernia at the time of a lower abdominal operation might unduly increase the risk of operation. Under such conditions the hernial sac can usually be removed from within the abdomen without increasing the operative hazard, provided no suppuration is present. While the removal of a hernial sac alone is usually adequate for children and has been recommended for adults,[5] this method is advocated only for those patients who during the course of a laparotomy may not tolerate a supplementary repair of the inguinal or femoral regions and yet will not be jeopardized by the additional removal of the sac.

The intra-abdominal removal of a hernial sac without abdominal repair can result in a permanent cure. Even if the result should be temporary, excision of the sac as an incidental procedure is justified since it involves so little time and risk. It will permit the patient to convalesce from the abdominal operation without the discomfort usual to a hernia and without the danger of strangulation. Moreover, even with abdominal repair, from 5 to 10 per cent of indirect and 10 to 20 per cent of direct inguinal hernias recur.[1] Banerjee[5] prefers to repair all inguinal hernias intra-abdominally, and of sixty-six patients so treated, including three for recurrent hernias, the results were satisfactory over a period of six months to three and one-half years. In inguinal hernias repaired by this method as an incidental procedure, the longest period of observation without return of the hernia was five and one-half years, the shortest interval, fourteen months. One patient with an inguinal hernia had no evidence of recurrence for eighteen months, but at the end of twenty-four months examination disclosed that the hernia was again present. In a femoral hernia which recurred promptly following two previous hernioplasties, no evidence of recurrence has appeared for nine months since the intra-abdominal repair.

While the Trendelenburg position facilitates the removal of the sac, it is not essential. The bladder should be empty. Any omentum or intestine within the sac should be reduced. An incision is made around the internal ring, the edges of the sac are seized with forceps and by careful dissection the sac is separated from the cord or round ligament and other adherent structures. If the sac is so large that dissection promises to be difficult and tedious, part of the sac can be left behind without complications.[1] The peritoneum is then approximated over the denuded area and any redundant peritoneum may be overlapped and approximated.

CASE REPORTS

CASE I. C. B., aged 33, a jewelry salesman, was seen on November 10, 1935, because of repeated attacks of subacute appendicitis of six months' duration. Fluoroscopic examination following the last attack confirmed the clinical diagnosis. Examination also revealed a right inguinal hernia of which the patient was un-

aware. On November 17, 1933, under gas-ether anesthesia an adherent, thickened, injected, and retrocecal appendix was removed by way

of acute appendicitis. Examination also disclosed a right inguinal hernia; this was of one and one-half years' duration. Under spinal
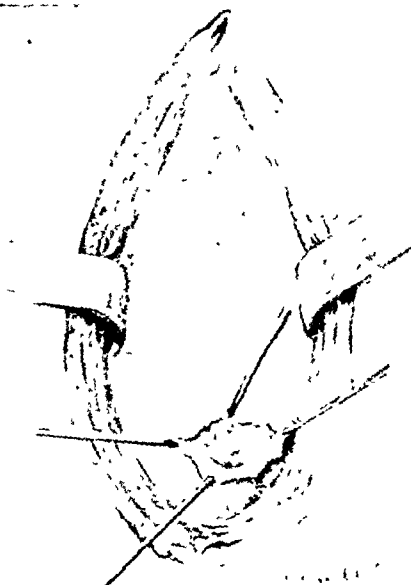
FIG. 1. Beginning dissection of hernial sac following incision around internal ring.

FIG. 2. Dissection of sac almost completed.

of a low, right rectus muscle retracting incision. Because of the patient's request that the hernia be repaired through the abdominal incision, a moderate sized hernial sac in the right inguinal region was also excised. In April 1939, five and

anesthesia and through a low, right rectus muscle retracting incision the appendix, which was acutely inflamed but not ruptured, was removed. Because the patient was stout and had a thick-walled, pendulous abdomen, and because an additional hernia operation at this time was deemed inadvisable, the hernial sac, which measured 3 inches in length, was removed intra-abdominally. Fourteen months later there was no evidence of hernia.

CASE III. A. F., aged 50, a housewife, was seen on March 4, 1939, because of symptoms due to uterine fibroids. Two operations within the previous four years for the repair of a left femoral hernia were followed by prompt recurrence. On March 5, 1939, under spinal anesthesia and through a median hypogastric incision a supracervical hysterectomy, bilateral salpingo-oöphorectomy, and appendectomy were done. The extent of the operation warranted no supplementary incision for the repair of the hernia; therefore, the sac, which measured $1\frac{1}{2}$ inches in length, was removed through the celiotomy wound. Nine months after the operation the result was still satisfactory.

FIG. 3. Approximation of peritoneum.

one-half years after the operation, there was no evidence of return of the hernia.

CASE II. S. G., aged 45, a coppersmith, was seen on November 1, 1938, because of an attack

CASE IV. M. S., aged 55, a retired grocer, was seen on April 19, 1932, because of an attack of acute appendicitis. He also had a right inguinal hernia of two years' duration. Under

spinal anesthesia a low, right rectus muscle retracting incision was made, and an acutely inflamed, unruptured appendix was removed. An additional hernioplasty at this time was considered ill-advised; therefore, an incision was made around the hernial ring, and the peritoneum approximated over the denuded area, but the sac was not excised. In September, 1939, seven and one-half years later, the abdominal wound was firm but an inguinal hernia was again present. The patient first noted recurrence about two years after the operation.

CASE V. C. S., aged 46, a housewife, complained of menorrhagia and a left inguinal hernia. Examination also showed many fibroids of the uterus. On August 15, 1935, under gas-ether anesthesia and through a median line incision a supracervical hysterectomy and bilateral salpingo-oöphorectomy were done. Because this was a difficult operation, an additional hernioplasty was contraindicated. The sac of the hernia, which measured about 2 inches in length, was removed through the abdominal incision. Eighteen months after operation there was no evidence of recurrence, but at examination six months later the hernia was again present.

SUMMARY

1. The intra-abdominal repair of a femoral or inguinal hernia is advocated for those patients who might be jeopardized by a supplementary hernioplasty at the time of an abdominal operation.

2. Several cases are presented illustrating various end results over a period of nine months to five and one-half years following this method of treatment.

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UPPER ARM BIRTH PALSY ASSOCIATED WITH CONGENITAL TORTICOLLIS*

CASE REPORT

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THE two conditions as observed in this case are occasionally associated. Their simultaneous occurrence has been reported and described although not frequently. One can readily realize the possibility of trauma during a difficult delivery, tearing or stretching the sternocleidomastoid muscle as well as parts of the brachial plexus. Apparently in this patient those nerve branches supplying the external rotators of the shoulder alone were damaged. The remaining musculature of the upper extremity was unaffected.

Besides correcting the deformities of wry neck and internal rotation contracture of the shoulder, it was decided to alter the imbalance between the paralyzed external rotators and the functioning and already contracted internal rotators. This was attempted by employing a procedure which has been described by L'Episcopo.[1] Briefly, this consists of a section of the tight internal rotators and adductors, namely, the pectoralis major, subscapularis, latissimus dorsi and teres major (Sever operation). Then the latissimus dorsi and teres major through their conjoined tendon are carried around the back of the humerus and are transplanted on its lateral aspect as far forward as possible. This changes their direction of pull so that they are converted into external rotators. Thus the main factor for recurrence of deformity is removed. This procedure was performed prior to correction of the torticollis as it was believed that the patient would have more time for muscle re-education. The possibility of less functional improvement with advancing age, if the patient waited, was also kept in mind.

CASE REPORT

The patient, a well developed and well nourished female, fourteen years of age, was first admitted to the hospital on August 24, 1938. She complained of deformity of the neck and disability of her left upper extremity. These conditions had been present since birth and she had attended clinics previously where she had been advised operative correction but had not received treatment. Her general medical condition was good. She demonstrated no physical defects other than of the face, neck and left upper extremity. Her head was tilted to the left so that the occiput was approximated to her left shoulder and the chin pointed up and to the right. This attitude was fixed by a definite contracture of the sternal and clavicular fibers of the left sternocleidomastoid muscle and the platysma. There was a flattening of the left side of the face but no other gross disfigurement. All motions of the cervical spine were free except for some restriction on tensing the shortened sternocleidomastoid muscle.

Her left upper extremity was maintained in an attitude of marked internal rotation and adduction. The left arm was moderately smaller in circumference than the right. Otherwise the left upper extremity did not vary from normal in appearance, function or length. External rotation was greatly restricted both actively and passively. She was barely able to raise her hand to her mouth. The pectoralis major, the internal rotators of the shoulder and the soft tissues of the anterior part of the shoulder were severely contracted. On attempting to abduct she was able only to bring the arm upward and forward instead of laterally from the trunk so that the posterior and lateral fibers of the

deltoid were not active. The teres major and latissimus dorsi functioned well.

X-rays of her cervical spine and left shoulder showed no defects; blood count and urinalysis were normal; and it was decided to perform operative correction of the upper arm birth palsy and congenital torticollis.

On August 31, 1938, under general anesthesia, the muscle transplant procedure was performed. The pectoralis major, teres major and latissimus dorsi were sectioned through a four inch incision along the anterior border of the deltoid. Then an incision was made along the posterior border of the deltoid. The conjoined tendon of the teres major and latissimus dorsi was identified medial to the long head of the triceps. This tendon was pulled posteriorly and passed under the long head of the triceps. The arm was externally rotated as far as possible and a thin osteoperiosteal flap was lifted from the lateral aspect of the upper third of the humerus. The tendon of the transplanted muscles was sutured here. A plaster shoulder spica was then applied with the arm abducted to 70 degrees and externally rotated.

After seven weeks the top of the cast was bivalved and removed daily to allow gentle rotation and abduction exercises. Due to the great amount of tension on the skin, the edges of the anterior wound pulled apart and gradually granulated in. The cast was removed entirely at the end of ten weeks at which time the patient had regained considerable deltoid power. She then started physiotherapy, active exercises and occupational therapy to help increase function.

On her second admission to the hospital fourteen months after the muscle transplant, the patient showed a definite release of her internal rotation contracture. She was able to abduct well, the arm going directly outward and upward away from the trunk. She was also able to bring the hand behind the head though this was not entirely due to action of the transplanted muscles in their new function. The patient stated that she was satisfied with the appearance and function of her left upper extremity.

On November 2, 1939, a wide section of the left sternocleidomastoid muscle was done and a head and body plaster applied with the head

in an overcorrected position. The wound had been sutured with a dermal subcuticular stitch and the cast was removed after six weeks. She was discharged to the out-patient department and physiotherapy and stretchings were instituted.

The patient was last seen on February 20, 1940. She presented a good cosmetic correction of her previous torticollis deformity. She has maintained a free range of active and passive shoulder motion but very little active external rotation. This is probably due to lack of use of the arm during immobilization following her second operation. She is again being given physiotherapy and occupational therapy and has been encouraged to use her left upper extremity in her daily tasks. The patient is satisfied with the results of both operations but it is hoped that she may regain some active external rotation as time goes on.

SUMMARY

1. A case of co-existing upper arm birth paralysis and congenital torticollis has been described. Although the possibility of this combination of deformities is mentioned in standard textbooks, a search of the literature has failed to reveal reports of such cases.

2. In this instance treatment for these conditions has been attempted at a rather late stage.

3. The cosmetic result following the torticollis operation has been very satisfactory.

4. Passive release of internal rotation contracture of the shoulder and freedom of abduction of the arm have been attained by means of section and transplantation of the internal rotators of the shoulder. This latter result has been maintained for almost two years.

5. It is hoped that use of the arm will improve active external rotation.

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TUBO-OVARIAN CYST CAUSING SEPSIS AND THROMBOPHLEBITIS

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THIS case of tubo-ovarian cyst is of particular interest because of the atypical and confusing clinical picture which developed from venous obstruction produced by a large infected tubo-ovarian cyst. Rarely in the practice of gynecology is widespread edema of the lower extremities observed, due to pelvic pressure, and certainly with greater infrequency do we encounter the clinical picture of sepsis or thrombophlebitis incidental to infection in an ovarian cyst.

The clinical course and pathologic evidence observed at operation, however, explained satisfactorily how the above picture was produced.

History. For five days before admission to the gynecologic service a 35 year old colored housewife, married for ten years, was confined to bed because of a sudden swelling of the entire left lower extremity. She had fever but no chills and mentioned that for the last six months there had been painless progressive swelling of her abdomen and also a generalized weakness and fatigability.

Her menstrual history was normal (14 × 30 × 7). The flow was always moderate except for clots during the past three years. A mild dysmenorrhea, principally premenstrual, was also mentioned. The patient was sterile although contraception had never been practiced.

Physical Findings. On admission the patient appeared to be acutely ill and somewhat uncommunicative because of her stuporous condition. Her temperature was 101 degrees and the pulse and respiration slightly increased. The abdomen was enlarged to the size of a full term pregnancy by an ovoid non-tender cystic swelling which was fairly well outlined and which seemed to arise from the pelvis. The entire left lower extremity was approximately two and one-half times normal size, due to a marked pitting edema delimited proximally by Poupart's ligament. While the joints were mobile and painless, the internal saphenous vein area of the thigh was slightly but definitely tender on pressure.

Pelvic examination revealed a nulliparous introitus and moderate edema of the left labia majus. The cervix was short; the anterior lip was hyperplastic and the external os was pin point. Pressure on the abdominal mass was not communicated to the cervix and conversely, cervical movement could not be transmitted to the abdominal mass. Both fornices were free and not tender. The left fornix was slightly lower than the right. The left sacro-uterine ligament area was infiltrated by a cord-like, slightly tender structure, the interpretation of which was obscure. A brownish cervical discharge indicated the cessation of the last period. Rectal examinations did not yield any additional information.

The intern's diagnosis at admission was ovarian tumor with left pelvic thrombophlebitis and edema of the left lower extremity.

Laboratory Findings. The blood count on the day of admission showed a marked anemia and leucocytosis: hemoglobin, 43 per cent; red blood cells, 2,730,000; white blood cells, 37,600; band neutrophiles, 22 per cent; segmented neutrophiles, 64 per cent; eosinophiles, 2 per cent; lymphocytes, 7 per cent; monocytes, 2 per cent, myelocytes, 2 per cent; metamyelocytes, 1 per cent.

A markedly active infection was also indicated by the Cutler blood sedimentation test, the index of which was 37 mm. in sixty minutes. Both Wassermann and urine tests were negative. A roentgenogram of the abdomen revealed on the flat plate "an intraperitoneal mass, most likely an ovarian cyst."

The diagnosis made by the gynecologic staff was essentially the same as that of our intern, except for the modification of ovarian torsion with secondary intracystic infection, and also

thrombophlebitis and possible sepsis, which were added after a twenty-four hour observation.

Repeated sedimentation tests and blood counts (Table 1) indicated a persistent infection, although the blood culture after a two-day

TABLE I
REPEATED BLOOD PICTURES

	11/14/39	11/16/39	11/17/39	11/19/39
Hemoglobin.............	43 %	46 %	45 %	43 %
Red blood cells.........	2,730,000	2,370,000	2,970,000	3,100,000
White blood cells.......	37,000	27,000	9,750	23,400
Band neutrophiles.......	12	22	17	18
Segmented neutrophiles..	76	57	67	72
Eosinophiles...........	2	2		
Lymphocytes..........	8	15	12	8
Monocytes............	2	4	4	2

incubation period revealed no growth of any organism. In addition the temperature became septic, ranging between 101° and 104°F.

Inasmuch as the patient was deathly sick, our opinion as to immediate treatment was conservative. Operation on admission and during the following few days was definitely contraindicated, not only because of the presence of local infection, but also on the basis of thrombophlebitis and the clinical picture of sepsis. While the surgical consultant suggested exploratory laparotomy at the time, medical and urologic opinions were similar to our own.

The following supportive treatments were therefore instituted: the edematous lower extremity was elevated and placed in a heat cradle. Daily measurements of the member indicated an increase in the swelling of the lower extremity (Table II.)

TABLE II
LEFT LOWER EXTREMITY MEASUREMENTS

	11/15	11/16	11/18	11/21	11/24
Upper left thigh.....	25.75	26.	26. Operation	26.	25.
Lower left thigh.....	17.5	17.5	16.25	17.5	16.5
Below knee.........	15.75	15.5	15.5	15.75	14.
Above knee.........	10.6	9.75	9.25	10.	8.7
Foot..............	10.45	10.75	10.25	10.	9.5

Sulfanilimide therapy (120 grains daily) was begun the day after admission and continued for six days, but in the absence of any clinical improvement this was discontinued, when the blood determination reached 15.1 mg. per cent

in the blood plasma. The patient was given a transfusion on account of the marked secondary anemia.
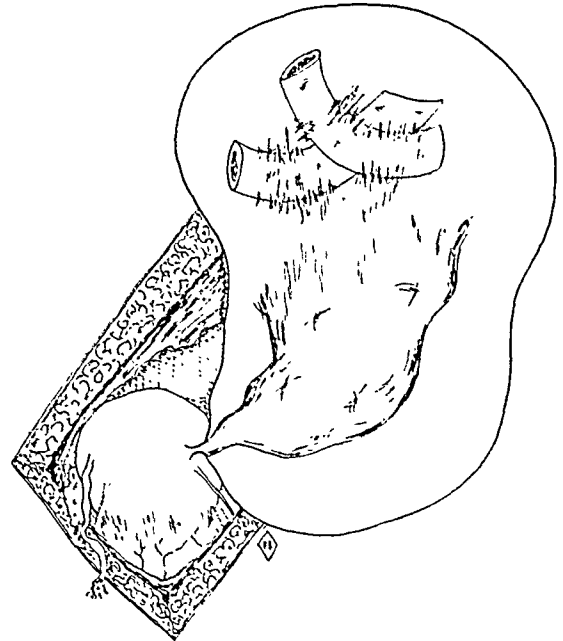
FIG. 1. Sketch showing large left tubo-ovarian infected cyst with small bowel adhesion.

Observation for one week under palliative and expectant measures revealed that the patient was becoming more toxic, as evidenced by a profound cloudiness of the sensorium, increase of leucocytosis and fever, and by the advance of edema beyond the inguinal ligament into the lower left anterior and posterior abdominal wall regions.

Thus after six days of downhill course with conservative treatment, further temporizing was considered inadvisable, since the patient was steadily approaching an agonal state. For this reason there seemed to be nothing to lose by an exploratory operation. The prognosis appeared to be thoroughly hopeless with or without surgery. Laparotomy was immediately performed under avertin and local novocaine block anesthesia.

Operation and Findings. Upon opening the abdomen a small amount of ascitic fluid escaped. Presenting into the wound was a huge, thick-walled, ovarian cyst and coursing over its mesial anterior surface, inseparably attached to it, was a markedly dilated, thickened pyosalpinx. (Fig. 1.)

When several loops of densely adherent small bowel were separated by blunt and sharp dissection, the cyst wall was torn and some serosal denudation of bowel occurred. The

latter was taken care of by approximating sutures. About 2 liters of thin, purulent fluid were suctioned from the cyst and a salpingo-oöphorectomy was performed.
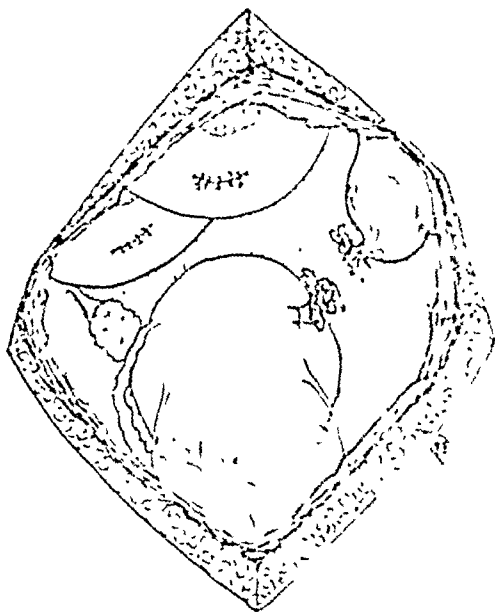
FIG. 2. Sketch showing markedly edematous left infundibulopelvic ligament after removal of tubo-ovarian cyst.

The left infundibulo-pelvic stump, approximately seven to ten times its usual size, was markedly thickened, edematous and pale. (Fig. 2.) Palpation suggested a thrombosis or a thrombophlebitis of its inner vessels extending proximally along the left common iliac vein.

It seemed, therefore, that this finding was the cause of the clinical picture of sepsis, the marked edema of the left lower extremity and the saphenous vein tenderness. The prognosis in view of this operative finding still remained hopeless. The postoperative clinical course, however, proved to be so atypical for thrombophlebitis and sepsis that our diagnosis was considered questionable, if not incorrect.

For two days after laparotomy the patient was apathetic, dull and toxic and her condition showed no improvement; but on the third day there was a radical drop in temperature, and from then on sensorium became more lucid. Edema of the left lower extremity and left lower abdominal and lumbar walls slowly but progressively decreased. A second transfusion was given at this time for the marked secondary anemia.

Except for a small decubitus ulcer over the coccygeal area, which eventually healed, con-

valescence was entirely uneventful. On December 14, 1939, twenty-four days after operation, the patient was discharged as cured. On a recent visit to our out-patient department she was found to be in good health and complained of no sequellae from the operation or obstruction in the left lower extremity.

The pathologic diagnosis of the removed specimen, reported by Dr. Ginzler, was tubo-ovarian abscess with the tube opening directly into the ovarian cyst lumen. The cyst fluid revealed no growth on culture.

DISCUSSION

In retrospect, the two outstanding points which have been clarified are: the cause of swelling in the lower extremity, and the cause for the clinical picture of thrombophlebitis and sepsis, which postoperatively proved to be more apparent than real.

In both humans and animals the toxicity of sterile pus is attested undeniably by clinical proofs too numerous to mention. The clinical picture of sepsis is often brought to a spontaneous and spectacular close by the simple release of encapsulated sterile pus. In this patient, it is conceivable that the sterile pus of the huge tubo-ovarian abscess drained slowly but constantly into the ovarian vein and the accompanying lymphatic system, thus producing the clinical syndrome of thrombophlebitis and sepsis. Within forty-eight hours after removal of the primary focus there was a spontaneous improvement, which rarely is observed in true septicemia or vein infection.

The operative finding, namely, thrombophlebitis (edema and induration), of the common iliac and ovarian vein (infundibulo-pelvic ligament enlargement) is explained on the basis of pressure, followed by venous and lymphatic stasis. Thus the pathogensis of the left lower extremity, as well as perivascular and retroperitoneal edema is explained by pressure phenomenon, while the symptoms of sepsis can be accounted for by toxic absorption.

Since with time, self-sterilization of pus tubes and ovaries takes place, it is not surprising that approximately one-half yield

negative bacteriologic cultures. The bacteria in order of frequency are gonococcus 15 per cent, streptococcus 8 per cent, acid-fast organism 5 per cent, staphylococcus 1 per cent, Bacillus coli 2 per cent. Hunter Robb isolated Bacillus proteus and Robert T. Frank reported Streptococcus hemolyticus in an 8 year old abscess.

Gebhardt found 226 instances of sterile contents in 409 pus tubes and Wertheim reported that 122 out of 206 pyosalpinges were sterile.

Unilateral pyovarium is not uncommon. In one hundred cases of pyovarium, A. Martin found 77 unilateral abscesses and 83 were accompanied by salpingitis.

In this case, since the lesion was unilateral and developed to a greater degree in the ovary, the origin may have been salpingitis causing secondary tubal agglutination over a course of many months. Many of these lesions have a puerperal origin and others, with or without tubal involvement, follow intra-uterine manipulation, principally early instrumental intervention of pregnancy.

The syndrome of sepsis which was present in spite of a negative blood culture, namely, high fever, clouding of the sensorium and the profoundly toxic condition of the patient, is satisfactorily accounted for by the amount and intensity of toxic absorption from local infection in the ovarian cyst, the pelvic soft tissues, and the perivascular retroperitoneal spread along the common iliac veins. The pathogenesis of these has been explained.

Torsion, rupture, thrombosis and hemorrhage are the usual complications of large, ovarian cysts.

In this case the complication was aseptic necrobiosis of a huge ovarian cyst with infiltrative pelvic and perivascular cellulitis causing toxic absorption as well as actual pressure on the common iliac and ovarian veins and their lymphatic systems, which produced edema of the lower extremity.

The combination of these give rise to the local picture of thrombophlebitis and the general impression of sepsis, and is so rare and unusual that it seems worthy of presentation.
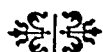
RECONSTRUCTION OF THE SCALP FOLLOWING EXCISION OF MALIGNANCY*

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CARCINOMA of either the basal or squamous cell type is not infrequently encountered on the scalp. Due to the anatomical characteristics of region, is not generally regarded as a potential location for the development of an epithelioma, but such an occurrence is not extraordinary. Some investigators have
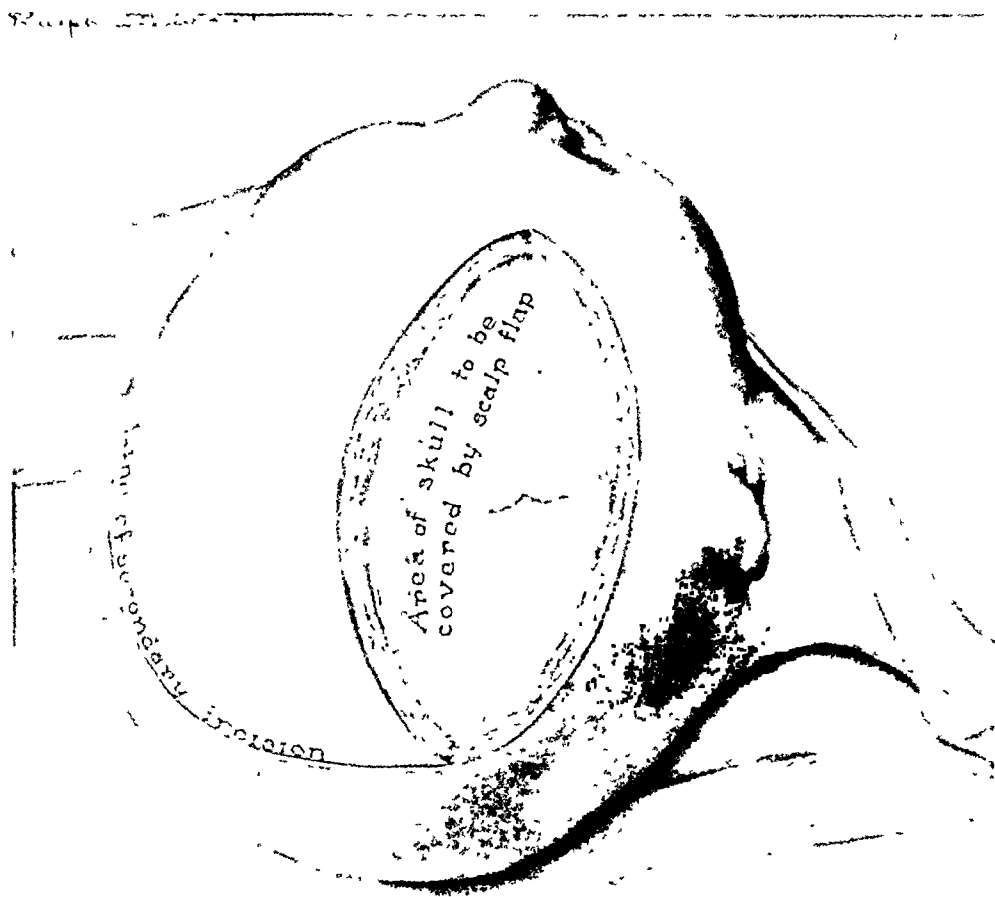
FIG. 1. The involved area has been removed by an elliptical excision down to and including the periosteum. The line of incision for the formation of a rotation flap is indicated.

this region, the problems of adequate surgical treatment and plastic reconstruction must be considered together.

Malignant changes may occur at the site of old unstable scars following scalp burns or other forms of trauma. The common sebaceous cyst so frequently seen in this noted malignancy in as high as 4 per cent of such cysts of the scalp. In Caylor's series of 236 sebaceous cysts, twelve were found to be malignant.

In general, epitheliomas in this region are slow to metastasize and slow to invade the deeper layers. Possibly due to the density

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of the galea aponeurotica, such lesions more often spread laterally or form papillary masses projecting from the surface.

experienced hands. Irradiation in doses necessary to produce the desired effect on a cancer which has progressed to the deeper
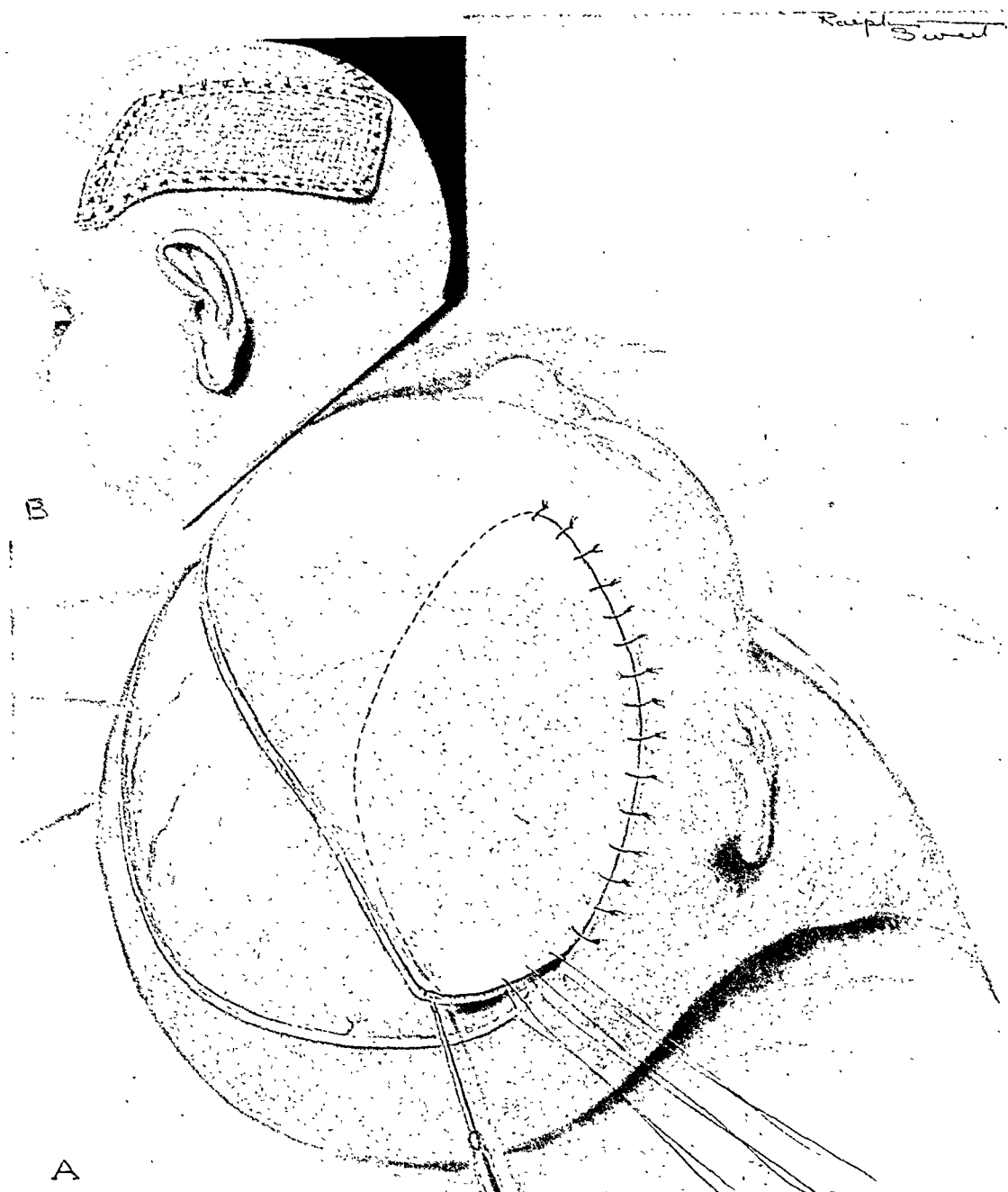
FIG. 2. A, the scalp flap has been shifted into position over the initial defect and partially sutured. B, graft and Tulle Gras have been sutured to the remaining defect, overlapping the edges.

Occasionally, however, invasion occurs early, and for this reason treatment must be directed deeply for the greatest margin of safety.

There are three principal methods of treatment in general use: irradiation, electrocoagulation and surgery. Each of these has its advantages and disadvantages, and each no doubt has proved efficacious in

layers of the scalp, may also be the cause of complications of a serious nature. Necrosis of bone and endarteritis of cerebral vessels are sequelae which have been known to follow this therapy. Pendergrass et al. have recently reported cases of three patients with malignancy of the scalp treated by irradiation, all of whom died from intracranial infection. The conclusion drawn

after postmortem examinations was that the infection followed a lowering of the resistance of that portion of the brain exposed to massive doses of x-ray.

FIG. 3. Showing the grafted area approximately three months after operation.

Electrocoagulation has been used on superficial lesions with success, but it is difficult if not impossible to direct such therapy down to the bone without producing bony necrosis.

Radical surgery, which is the only type of surgery indicated, can excise these growths down to and including the periosteum without producing any of the above mentioned complications. Such treatment will create large scalp defects, but with proper planning, these can be reconstructed with suitable plastic procedures. The following case history of a carcinoma of the scalp arising from a sebaceous cyst exemplifies the type of reconstruction which may be employed:

Mrs. M. M., aged fifty-nine, was first seen on August 20, 1938, at which time she complained of two wens on the scalp. Two years previously a large wen had been removed from approximately the same location. On examination two sebaceous cysts about the size of walnuts were seen close together, one of which adjoined the scar from the prior operation. On palpation, the cyst overlying the scar felt

harder and more firmly fixed to the tissues than the other. The scar itself presented a few small hard nodules along its length. A biopsy of the cyst was diagnosed as squamous cell carcinoma. It was therefore decided to excise the entire area containing the cysts and scar.

On August 26, 1938, under general anesthesia, the involved area was excised down to and including the periosteum. The defect thus produced measured 5 by 3 inches. Since there was now no base upon which to place a free graft, a rotation flap of adjoining scalp was raised up, shifted into position and sutured over the defect, using Deknatel interrupted sutures. The area left by this maneuver had a base of subaponeurotic tissue, which was suitable for the application of a graft.

Using the right thigh as a donor area, several intermediate grafts were cut and spread on Tulle Gras, raw surface uppermost. This technic facilitated the handling of the grafts. The skin was next placed in apposition with the area to be grafted, with edges overlapping. Sutures of Deknatel No. 1 were placed to anchor the graft to the surrounding scalp. Moistened gauze sponges, a marine sponge, and an Ace bandage furnished a pressure dressing. The donor area was dressed with layers of vaseline gauze. On September 5, 1938, the tenth postoperative day, the dressings were removed, sutures removed and the graft was found to be a complete take. The head was rebandaged in a similar fashion for another ten days after which time further dressings were unnecessary.

SUMMARY

Three methods of treatment for malignancy of the scalp are discussed: radiation, electrocoagulation and surgery, with the advantages and disadvantages of each. A case history of a carcinoma of the scalp arising from a sebaceous cyst is described, with emphasis on the reconstruction of the scalp following radical surgical excision.

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INTESTINAL OBSTRUCTION CAUSED BY GALLSTONES

CASE REPORT

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A RECENT article from the Mayo Clinic[1] states that "the rarest of all the reasonable ways in which the intestine may become obstructed is by gallstones." The authors reported ten cases that have been observed at the Mayo Clinic, the diagnosis having been made either at operation or necropsy. Moore,[2] in 1925, estimated that 400 cases had been recorded.

The common mechanism of such obstruction is by the formation of a cholecystoenteric fistula from perforative cholecystitis, although of more rare occurrence may be cases of perforation of peptic ulcer or carcinoma. The site of obstruction has usually been in the terminal portion of the ileum. The case here reported is similar in both respects, being from a perforative cholecystitis and the final obstruction resulting from impaction of the stone in the ileum. It differs in that the signs and symptoms might be interpreted as characteristic of an obstructive body passing through the intestine.

CASE REPORT

Mrs. L. M. K., a house-wife, age 68, had been in poor health for ten years. After the birth of her ninth child, she had a very severe phlebitis in her right leg, with a marked residual lymphedema. Since 1928, she had suffered from diabetes which was comparatively mild and controlled by diet. In 1930, following an acute upper respiratory infection, there had been an attack of acute nephritis with edema and hypertension, and a resulting chronic nephritis. During 1936, she had suffered several attacks of pain in the upper right quadrant which were diagnosed as gallstone colic. On May 14, 1937, she had an attack of severe generalized, cramp-like, upper abdominal pain. The pain also radiated to her back on the right side. She vomited several times with the onset of pain. During the next two days, the pain was said to have shifted from the upper right quadrant across the midline to the left, then to the left lower quadrant. It occurred in severe paroxysms between periods of comparative quiesence.

During my absence from the city, another physician attended her and administered morphine to relieve the pain. This was repeated several times in the next two days but she continued to have pain and to vomit. I first saw her on May 17. Examination revealed a very sick woman complaining of intermittent cramp-like pains in her abdomen and constant nausea and vomiting. She stated that she had a bowel movement on the morning of the onset but none since. Her temperature was 100 degrees and pulse 105. She was dehydrated with coated tongue and flushed cheeks. Chest examination revealed nothing of significance. Her abdomen was uniformly distended. The upper half was fairly soft with but slight tenderness over the gallbladder region; the lower half was very tender with muscle spasm on both sides. Urinalysis revealed: specific gravity, 1.011; albumin, negative; sugar, negative. The sediment contained many pus and epithelial cells and tissue débris. The white blood cell count was 6000, with 77 per cent polymorphonuclears.

With a diagnosis of acute intestinal obstruction of unknown origin, immediate laparotomy was done under a spinal anaesthesic. When the abdomen was opened, a large quantity of serous fluid and a greatly distended small bowel were found. Exploration revealed obstruction about 3 feet proximal to the cecum by an ovoid body. The intestine was incised longitudinally and the mass removed. Closure was done transversely by a Connell suture of intestinal catgut and a peritoneal layer of Lembert sutures of silk. Further exploration revealed a mass of adhesions between the gallbladder and duodenum. These adhesions were not disturbed. The abdomen was closed with drainage tubes in place.

The obstructing body, when examined, proved to be a gallstone 3 by 4¾ cm. in size, with a smooth surface except for a deep facet in one end.
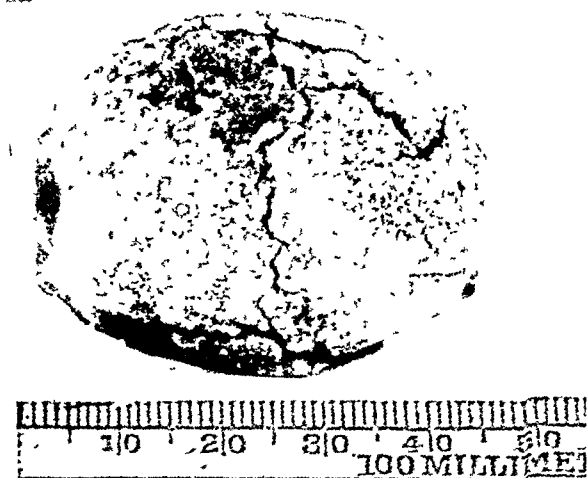
FIG. 1. Gallstone, which caused intestinal obstruction.

The postoperative condition of the patient was good until the fifth day when signs of peritonitis appeared. She grew worse and died on the ninth postoperative day. An autopsy examination was not performed.

SUMMARY

A case of acute intestinal obstruction caused by impaction of a gallstone, following formation of a cholecystenteric fistula, is reported. This case might have been diagnosed preoperatively from (1) the previous attacks of gallstone colic, and (2) the shifting character of the pain as revealed by the history in the presence of all signs of an obstruction.

In reviewing the case, it seems that had I been more alert to this possibility, the diagnosis might have been made from the latter point since any other cause of an obstruction in this patient would have remained at a fixed location, without the shifting pain and tenderness which occurred with the downward passage of the stone.

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FETAL RESUSCITATION AFTER SEEMING DEATH*

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THE exact moment of death in a human organism is difficult to fix. A heart may stop only to start again, breathing may cease and be effectively re-established, and both breathing and heart action may be present in an organism in which vital physiologic processes are otherwise already arrested. Cessation of cellular activity after failure of respiration and circulation proceeds at varying rates in different tissues.

Therefore, while in the subsequent case report the condition of the fetus is referred to as "seemingly dead," it is done advisedly in anticipation of the irrefutable argument that anything physiologically "dead" cannot be revived. The purpose of this report is to stimulate exhausting attempts to revive seemingly dead babies in which no gross organic pathology is noted. Also it discredits the commonly accepted belief of extreme sensitivity and early death of anoxemic brain tissue, and emphasizes the need for positive measures to revive babies born with "asphyxia neonatorum pallida."

CASE REPORT

Mrs. I. G., a twenty-two year old primagravida, whose estimated date of confinement was October 8, 1937, was awakened at 1:30 A.M. October 1, 1937, when the membranes ruptured. There followed occasional slight pains and a sensation of bladder pressure. When voiding at 6:30 A.M. she noticed approximately eight inches of cord protruding from the vagina. She was admitted to the hospital by ambulance at 7:10 A.M. with faint, slow pulsations of the cord present. On arrival in the delivery room at 7:15 A.M., twenty inches of cord were prolapsed, there were no pulsations, no fetal movements were felt and no fetal heart was heard on careful abdominal auscultation. The cervix was four and one-half fingers dilated with a double footling breech presenting. Since the pelvis seemed ample and signs of fetal life had only recently disappeared, accouchement forcé was performed, with some difficulty encountered in delivering the after-coming head through the incompletely dilated cervix.

The baby was born at 7:38 A.M., eighteen minutes after cord pulsations and other criteria of fetal life were known to be absent. Infant asphyxia pallida, flaccidity and absent heart sounds were noted, with no precordial or umbilical beat and no respiratory efforts. Coramine ampule 1 intramuscularly was given two minutes after birth. Four minims of adrenalin were given intracardially four minutes after birth and forty seconds later spasmodic cardiac contractions were detected. Intra-tracheal insufflation by Flagg apparatus was begun and fifteen minutes after birth and thirty-three minutes after the fetus was seemingly dead, the baby initiated breathing efforts. He was placed in a tub of warm water and 5 per cent to 95 per cent CO_2-O_2 given by inhalator for thirty minutes. The first cry was timed twenty minutes after birth.

Prognosis was still guarded due to the prolonged cerebral anoxemia.

The subsequent course while in the hospital was uneventful. The baby nursed well and left the hospital on the fourteenth day slightly over its birth weight of 3,150 Gm.

The child was examined again October 9, 1939, at the age of two. He is physically and neurologically normal and his mental development is advanced beyond the normal for that age.

CONCLUSION

The conclusion to be drawn from this experience is that seemingly dead, newborn babies should be given intracardiac adrenalin in small dosage and forced pulmonary ventilation in conjunction with other therapy, in attempts to revivify them. The rare occasions of good results (two in our experience) make the fruitless efforts in the vast majority worth while.

* From The Margaret Hague Maternity Hospital, Jersey City, New Jersey.

UTEROVAGINAL FISTULA AND PREGNANCY

REPORT OF A CASE ASSOCIATED WITH AMPUTATION OF THE CERVIX WITH CLOSURE OF THE CERVICAL CANAL TREATED BY CESAREAN SECTION

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A REPORT of this case is warranted because of its extremely unusual features, a similar case not being found in a thorough search of the literature.

A multipara, white, 35 years of age, at full term, was admitted to the hospital with the history of several moderately severe vaginal hemorrhages during the previous six to seven hours. There were no uterine contractions. The patient was in good condition with a pulse rate of 90 per minute. The fetus appeared full term in size, position left occiput posterior, head nonengaged, fetal heart rate 144 per minute, good quality. Admission diagnosis of placenta previa was made and the writer was asked to see the patient.*

Abdominal findings were as above. On rectal examination the cervix could not be felt. Vaginal and speculum examination revealed the following: complete absence of the cervix with closure of the endocervical canal, there being merely a dimpling 2 to 3 mm. in depth impermeable to a probe at the site of the cervix. Three cms. to the right and 2 cms. anterior to this dimpling an opening was seen, from which blood was oozing. On examination this was found to be a uterovaginal fistula, 2 cms. in width, which showed a recent tear and hemorrhage. The fetal head was felt through this opening. The placenta was not in reach of the examining finger, though deep exploratory palpation was naturally avoided.

The previous obstetric and operative history of the patient is of pertinent interest: There had been one other pregnancy, terminating, after four days of labor in a midforceps delivery of a male child, weighing 5 pounds, 13 ounces. This child, now 8 years of age, has

*The history from this point was withheld from the patient's physician, as she was operated upon without his knowledge and did not want to antagonize him.

suffered ever since birth from mental retardation and convulsive seizures, probably resulting from cerebral damage from the prolonged labor and forceps.

Four years following the birth of this child the patient had a "high amputation of the cervix." Her hospital stay was featured at this time by repeated attacks of fever and pain in the lower portion of the abdomen. It is uncertain whether the uterovaginal fistula developed at the time of the patient's prolonged labor and was not seen or not repaired at the time of her operation, or whether it resulted from closure of the endocervical canal at the time of operation with subsequent infection. It is more probable that the fistula dates back to the time of her delivery. Since the birth of her first child the patient has been menstruating normally with complete absence of pain, whereas previously, dysmenorrhea was marked. This fact would speak for the production of the fistula at the time of labor. Certain it is that the patient became pregnant by the penetration of the spermatozoa through the vaginouterine fistula.

To avoid irreparable damage to the pelvic structures (who would have dared to deliver this woman from below?) a two-flap low cesarean section (laparotrachelotomy) was done, with the birth of a normal living female child, weighing 7 pounds, 5 ounces. The placenta was situated well away from the lower uterine segment. The postoperative course was uneventful; the wound healed by primary union and the patient and baby were discharged on the thirteenth postoperative day.

It was believed in this particular case that one could only get into difficulties and gain nothing by an attempt to repair the fistula and re-open the endocervical canal. The patient has been so informed and is abiding by this decision.

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The author is grateful to the patient's private physician, Dr. M. Graff, for permission to publish this interesting case.

SUMMARY

A case is here reported of a uterovaginal fistula with a fullterm pregnancy, associated with a previous "high amputation of the cervix," with complete closure of the cervical canal. Origin of the fistula is discussed. Pregnancy resulted from the penetration of spermatozoa through the vaginouterine fistula. Treatment was by low cesarean section with the birth of a normal child and an uneventful recovery of the mother.
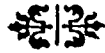
FIBRO-MYOMA of the uterus is by far the commonest tumor of that organ. It produces hemorrhages at or between the menstrual periods, and anaemia results.

The brief excerpts in this issue have been taken from "Physical Diagnosis" by Richard C. Cabot (William Wood & Company).

New Instruments

AN APPARATUS TO FACILITATE THE TREATMENT OF COLLES' FRACTURES*

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THE apparatus to be described below will be better understood by a brief review of the treatment of Colles' fracture. The fracture must first be satisfactorily reduced with particular care to correct not only the posterior displacement but also the radial displacement of the distal fragment of the radius. An anesthetic, general or local, is required for this reduction. Gas-oxygen inhalation anesthesia, supplemented occasionally by ether, is the usual method of choice. Following reduction, the forearm, wrist and hand must be kept in the position best suited for the maintenance of the reduction by an assistant or assistants while some form of splint is being applied. The position is usually one of more or less flexion and varying degrees of ulnar deviation of the wrist. The method of maintaining the position is usually one involving the use of plaster of Paris, either in the form of anterior and posterior slabs, or a circular plaster cast from the elbow to the heads of the metacarpals. It is necessary to maintain anesthesia until the cast has hardened.

Several technical difficulties are encountered in this procedure. The first is the necessity for an assistant to hold the reduced fracture in the proper position while the cast is applied. Even expert assistants are in the way and very often make careful, snugly fitting casts difficult to apply. More often than not, the assistant available is not particularly skillful and his fingers are a hindrance to the application of the cast. As a result there may be changes in the reduction position from the optimum first obtained by manipulation. The second difficulty is the necessity for continued anesthesia as one applies the cast and until it hardens. The third difficulty is the fact that the surgeon very often sacrifices the lightness of the cast by adding excessive plaster so that the cast will harden more quickly and make unnecessary prolonged holding of the wrist and hand in the desired position.

The apparatus designed to obviate these difficulties is illustrated by the accompanying photographs. (Figs. 1 and 2.) It is mounted on a wooden board which measures approximately 24 inches by 7 inches. At its center is a 3 inch high, upright tube, (A), which sets into a base. Into this tube slides a slightly smaller tube, (B), of similar length. The height and position of the inner tube with respect to the outer tube is controlled and locked by a set screw, (C). Attached to the inner sliding tube at its upper end is a ball and socket joint, (D), so made that by twisting a threaded cap, it may be tightened or released. The ball has mounted on it a round metal shaft 1 inch long and ¼ inch thick (E). Its upper end has welded to it a rectangular shank, (F), ⅜ by ¾ of an inch. Resting on this square shank is a curved wrist rest, (G), which is made of thin-rolled steel. At its midportion it has a

rectangular opening, (E), just large enough to get securely on the rectangular end of upright. One end of this bar curves up to a

hand the metal rest of curved bar, (G), is rotated 180 degrees and reset on the square end, and the traction rod is slid out of its
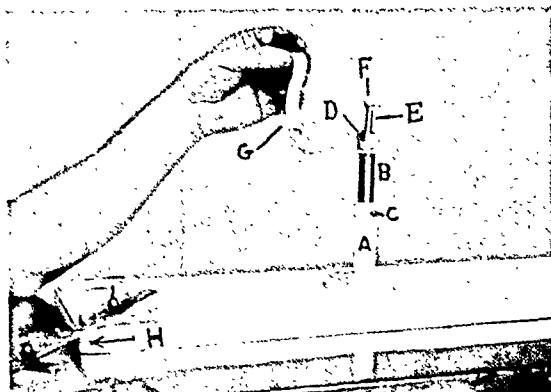
FIG. 1. This view demonstrates the entire apparatus with the wrist rest removed from the rectangular end of the metal post. Note square opening in wrist rest.
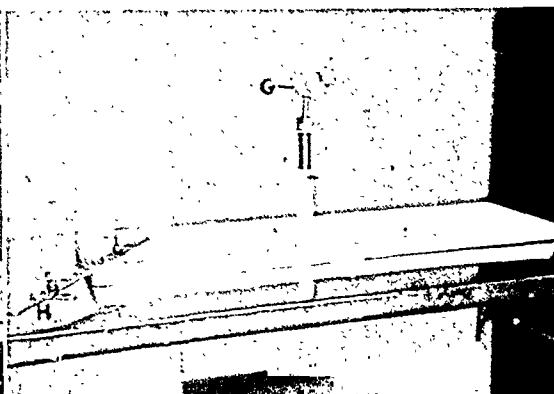
FIG. 2. Apparatus completely assembled for use with left wrist. Wrist rest in site; traction bar placed on left hand slot for traction in position of ulnar deviation.

FIG. 3. Fracture reduced (right wrist). Finger traps applied to index and ring fingers; rubber band traction to traction bar.

FIG. 4. Sheet wadding applied.

much higher point than the opposite end and then curves back on itself to make a sort of hook.

At one end of the apparatus is a traction device, (H), which swings into any position and may be attached to a slot at either side of the end of the board. This traction bar may be locked in any position by a set screw and has hooks on it for rubber band traction. The bar may be so placed, therefore, to secure traction with varying degrees of ulnar deviation for either hand.

USE OF THE APPARATUS

The fracture is reduced under general anesthesia and then immediately placed on the apparatus as per Figure 3. If it is a left

groove and placed in the groove on the other side of the board. A piece of thin felt or cotton is placed between the wrist and the wrist rest, (G). If a stockinette has been used, the latter is not necessary. Finger traps of the Japanese bamboo variety are applied to the index and middle or ring finger, two of these usually sufficing. These finger traps when pulled grasp the fingers snugly. Rubber bands have been passed through the ends of the traps. The other end of the rubber band is attached to the hooks on the traction bar. The particular hooks they are attached to are determined by the amount of ulnar deviation that is desired. By elevating the tube, (B), more flexion may be obtained.

Placing the reduced wrist in the apparatus takes but a moment or two. The moment this is done the anesthetic may be

buckle, although this is not necessary. Then, without the need of any assistants it is possible to wrap sheet wadding around
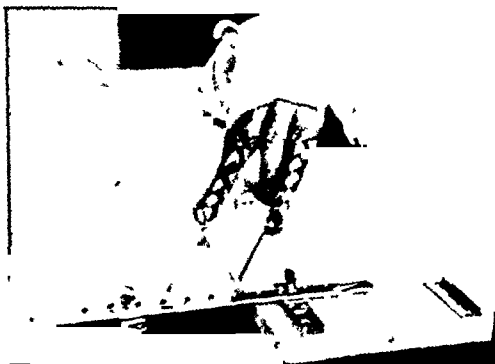
FIG. 5. Cast applied; end on view.
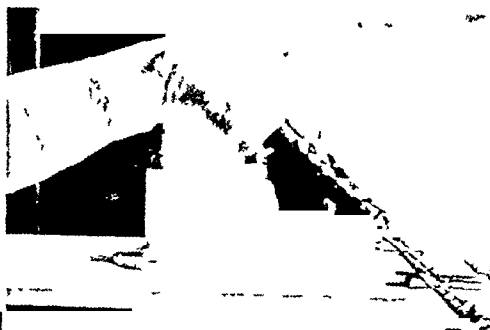
FIG. 6. Cast applied; lateral view.

FIG. 7. Forearm with cast applied, lifted off metal post. Note curved end of wrist rest protruding through cast.

FIG. 8. Wrist rest rotated slightly out of cast.

FIG. 9. Wrist rest more completely rotated out of cast.

FIG. 10. Wrist rest completely rotated out of cast.

stopped and the patient allowed to recover from it. Because the patient is lying flat with elbow extended and wrist locked, the position of the fragments is secure from the effects of any motion of the patient's trunk. If one desires, the elbow may be strapped to the board by a strap and

the forearm, wrist and hand. (Fig. 4.) Following this plaster of Paris is applied over the sheet wadding. This can be done leisurely, molding it carefully, particularly along the radial side of the second metacarpal bone to maintain the position of ulnar deviation. Figures 5 and 6 demon-

strate the iron wrist rest with its curved end protruding. Figure 6 also shows the metal shaft, (E), protruding from the bottom of the cast. Because there is no need for hurrying, the cast may be made very light and the arm with cast applied may be kept on the apparatus until it is completely dry and firm. Then the cast with the wrist rest or curved bar, (G), incorporated in it is lifted off the rectangular end of the metal post, (E). (Fig. 7.) At this point the reason for bending the curved bar back on itself becomes obvious. It will be appreciated that this curved bar rests under the wrist, and between it and the wrist is either a small piece of felt or stockinette. Lying against the outer surface of the bar is the sheet wadding wrapped around the entire arm. By placing the index finger under the hook of the curved bar and pulling it up in

a curved direction which follows the curve of the bar, it slides out very easily. (Figs. 8, 9 and 10.) The small slit opening through which it slides out and the small $\frac{1}{4}$ inch opening on the anterior surface through which post, (E), is slipped, may either be left uncovered or covered with a turn of plaster of Paris bandage. The cast is then trimmed in the usual manner.

CONCLUSION

An apparatus which facilitates the treatment of Colles' fractures is described. It makes necessary only a very short period of anesthesia and eliminates the need of an assistant. It makes possible better, lighter and more closely fitted casts. Its use minimizes the possibility of changes in position of the fracture during application of the cast.
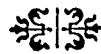
A SIMPLE HOLDER FOR VENTRICULOSCOPE OR BRAIN CANNULA*

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IT is often necessary, during ventriculography or the tapping of a ventricle for other reasons, to allow the cannula

FIG. 1. Holder for ventriculoscope or brain cannula.

we use. The outside diameter of the sphere is the same as that of the Hudson burr used to make the bony opening, so that it will fit
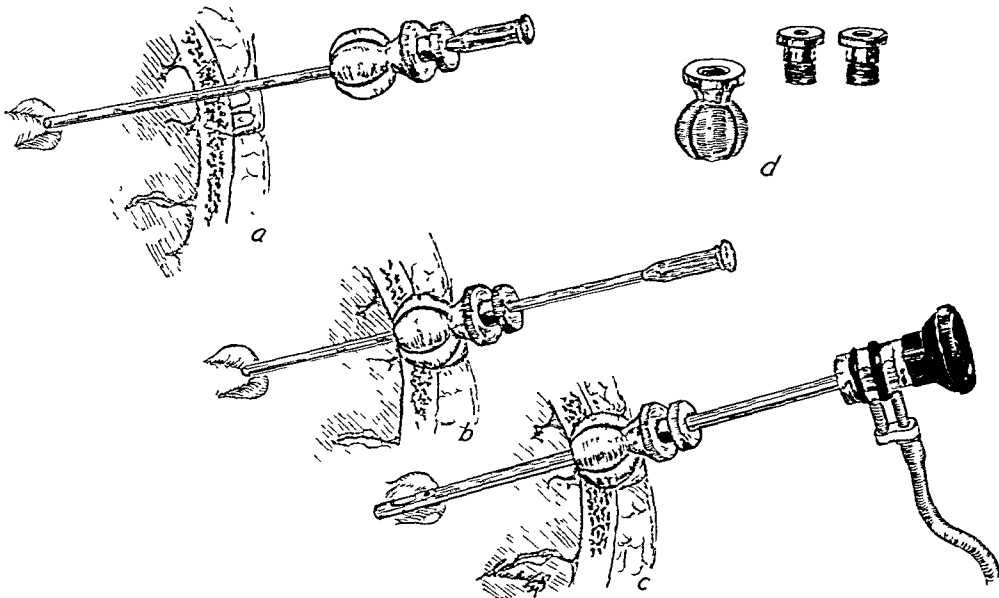
to remain for more than a few minutes at a time. The protruding end must not be allowed free play in the burr hole through which it is inserted. Even when held by an assistant with a forcep, there is often some undesirable lateral motion of the deep end of the instrument in brain tissue.

The small device illustrated* was designed to eliminate this hazard. It is a steel sphere, with a protruding handle, perforated to receive loosely either the Adson brain trocar or the small examining ventriculoscope of the same diameter, which

fairly snugly in the burr hole. The lower end of the sphere is notched to give the sphere a slight spring.

When used, the cannula, or ventriculoscope, is passed through the opening of the sphere and then inserted as nearly through the center of the burr hole as the position of the gyrus and surface vessels will allow. It may be inserted at any angle. (Fig. 1A.) When the instrument in use reaches its proper position in the ventricle, the small sphere is moved down the shaft until it engages the burr hole. The trocar is then held free of lateral motion, while it can be advanced or withdrawn as desired. (Fig. 1B.)

* These instruments were made for me by Mr. Alex Barna of Duquesne, Pennsylvania. The illustrations were made by Miss E. M. Shackelford of the Oliver Research Laboratory.

* From the John C. Oliver Memorial Research Laboratory, St. Margaret Memorial Hospital.

PROCTOSCOPE GUIDE FOR ELECTRODES AND SNARES

H. D. FURNISS, M.D., F.A.C.S.

NEW YORK, NEW YORK

DIFFICULTY in accurately placing the tip of long proctoscopic electrodes, particularly when they are at proctoscope and the electrode, the tip may be accurately and surely directed to any desired spot. This instrument has been
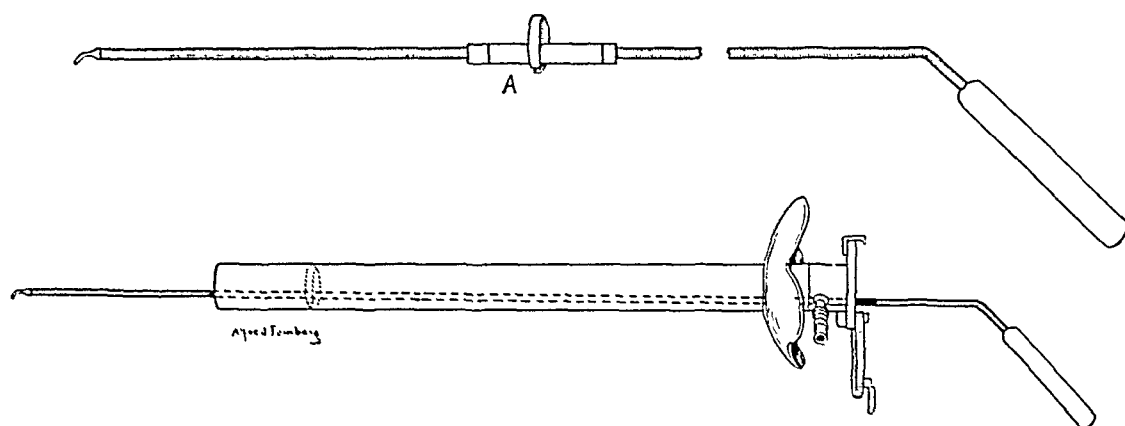
FIG. 1.

all flexible, led me to devise the guide herewith illustrated. The principle is that of the cue bridge used in billiards and pool.

Guide A consists of a ring that has an easy fit for the proctoscope and a portion through which the electrode passes. The electrode slides easily through the guide and can be shifted to any position in the proctoscope channel. By manipulating the

used, with great satisfaction, with both electrodes and snares.

There are many different proctoscopes on the market, and a slightly different guide will be required for each. Any good instrument maker can fashion a fitting guide at small expense.

The guide here illustrated was made by the American Cystoscope Makers, of New York.
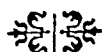
Selected Book Review

BONE GRAFT SURGERY IN DISEASE, INJURY AND DEFORMITY*

By Fred H. Albee, m.d., ll.d., sc.d., f.a.c.s.

Assisted by Alexander Kushner, m.d.

THIS book will have a wide appeal to the orthopedist, the surgeon who does reconstruction surgery and to certain general surgeons whose field or practice extends to those patients requiring bone graft surgery. That the author is a pioneer in this surgical domain goes without further comment. In 1915, he wrote a book on this subject that had a wide distribution. Even then his accomplishments in the field of bone graft surgery were considerable, and he was known in the civilized world wherever bone surgery was done. The writer remembers attending a lecture given by Dr. Albee early in 1917, and watching moving pictures showing his technic of bone graft surgery.

VALUE OF BONE GRAFT SURGERY

The author tells us that he has incorporated those procedures which have stood the test of time. For the most part he deals with procedures he himself uses, but also has included procedures by other surgeons of mature judgment. Bone graft surgery is utilized today in an ever increasing variety of ways: The reconstruction surgeon is able to cope with the unfortunate sequelae of industrial and road accidents; the therapy of congenital absence of many bones can now be undertaken with greater assurance than formerly; the Albee Bone Graft spine fusion operation has made the treatment of a wide variety of spinal affections less formidable; and it is believed that the graft peg is the ultimate solution of those cases of central fracture of the neck of the femur when the ligamentum teres has been ruptured at the time of the fracture, a frequent occurrence. These are

but a few of the conditions for which this type of surgery will prove beneficial.

<div align="center">THE BOOK</div>

The book has nine chapters: The General Principles of Bone Grafting, Armamentarium of the Orthopedic Surgeon, Spine Fusion,
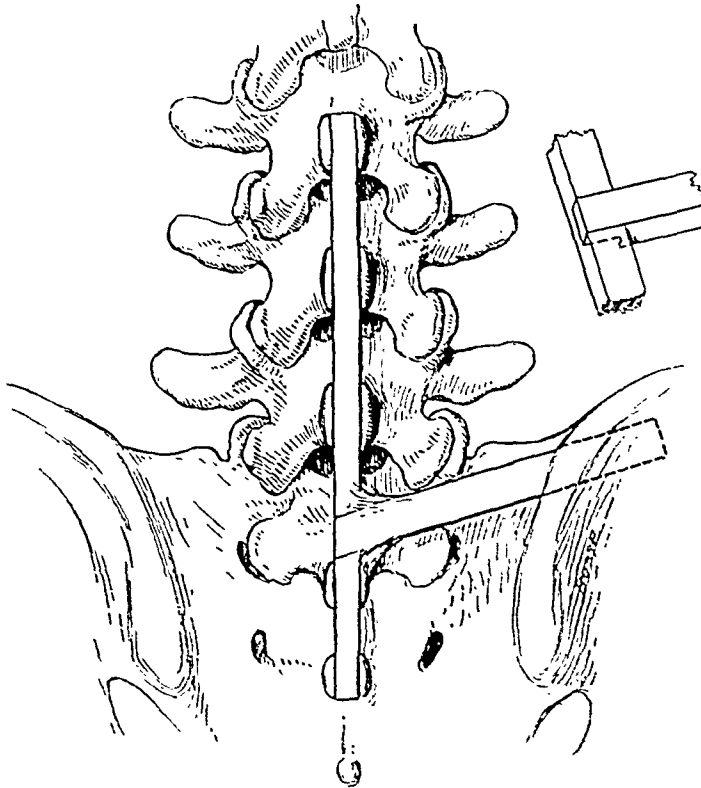
FIG. 1. Diagram from the roentgenogram of an actual case of tuberculosis of the last lumbar vertebra and the right sacro-iliac joint. The spine graft was inserted by the author's regular technic for Pott's disease. The graft controlling the sacro-iliac joint was joined by a carpenter's half mortise to the spinal graft (see small upper right-hand drawing). The callus uniting the two grafts is indicated. The graft was joined to the posterior wing of the ilium by shaping it into a wedge end which was forced into a split in the ilium made by an osteotome. (Figure 76, in Albee's Bone Graft Surgery, D. Appleton-Century Company, Inc., originally in Albee's Orthopedic and Reconstruction Surgery, W. B. Saunders Co.)

Bone Graft Surgery of the Hip Joint, Bone Graft Surgery of Un-united Fractures, Bone Graft Surgery for Replacement of Bone, Plastic Bone Graft Surgery, Arthrodesing Bone Graft Operations

and Bone Block Operations. It contains approximately 300 illustrations and has an ample Bibliography at the end of each chapter. There are also an Index of Authors and an Index of Subjects.

A   B
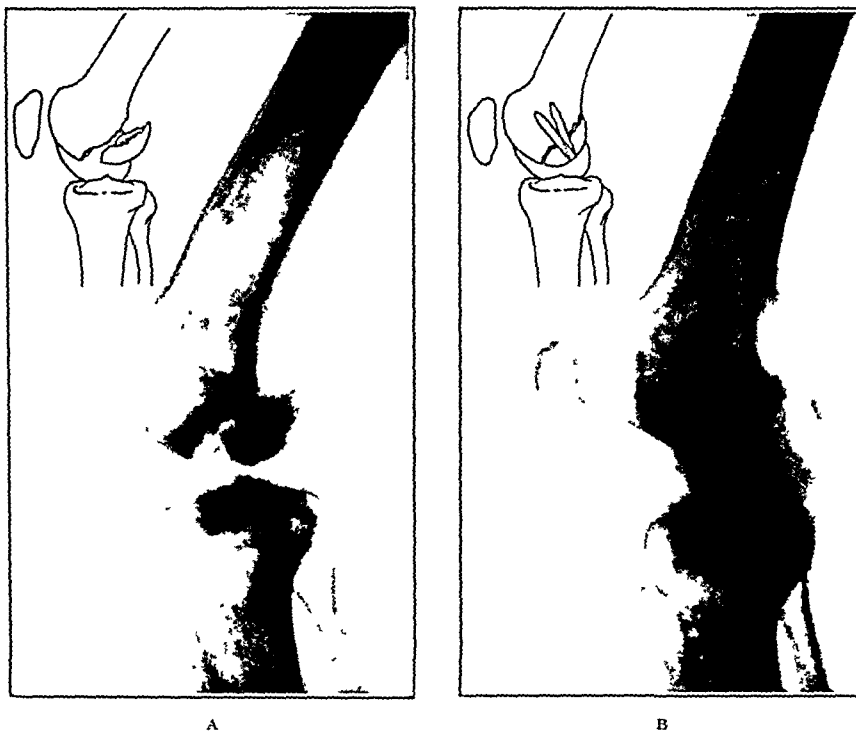
FIG. 2. A, ununited fracture of femoral condyle of two years' duration. B, bony union after coapting the fractured fragments with two bone graft pegs. (Figure 146, in Albee's Bone Graft Surgery, D. Appleton-Century Company, Inc.)

It is a readable, concise, scientific book on a subject that is more important today than ever before, written by a pioneer and master of this type of surgery.

Editorial

YE OLDE EDITORS' BATTLE

SINCE Britain and America have united against der Fuehrer and America has come of age as a world power, it is easy to forget that we were not always so respected. With the hands-across-the-sea sentiment fast developing into a political amalgamation, medical editors of both countries can rejoice that the old feud is dead. American medicine since 1900 has attained world recognition and its puerility is admittedly over.

As Eckman[1] has recently pointed out, before the turn of the century British and American journals often made it a policy to ridicule each other. It was the same narrow self-sufficiency that made George Ticknor's Boston intolerant of budding intellectuality in the rest of America. The battle was joined in 1818 when the *Edinburgh Review* commented thus of a Philadelphia publication: "What does the world yet owe to American physicians or surgeons?" For four years the *Philadelphia Journal of Medicine and Physical Sciences* carried this quotation on its masthead to goad Americans and to keep alive the familial dissension. In his first edition the editor of the Philadelphia Journal complained that: "Ever since the establishment of our Independence it has been the habit of Europe very wantonly to traduce our . . . achievements. Calumnies from this source . . on each repetition (are) marked by

fresh acrimony and insolence." Six years later this same Philadelphia editor struck out once more at impertinent and presumptuous English critics and quoted the *London Medical and Physical Journal:* " . . . The editor cannot recollect anything of any consequence that has been done by American physicians and surgeons!"

In 1828, the *Boston Medical and Surgical Journal* joined the conflict and reprimanded the editor of the London *Lancet* for calling prominent practitioners " . . . bats, cocksparrows, ninnyhammers and other (names) scarcely less felicitous . . . " Four months later the Boston editor pounced on a book written by Michael Ward, M.D., of Manchester, England, saying: "The sum total of this work is that burns and scalds may be cured by common wheat flour . . . this much information . . . and no more."

Wakley, editor of the London *Lancet,* proposed in 1830 that poverty-stricken English physicians should be shipped out to America. To this the *Boston Medical and Surgical Journal* howled: " . . . as for gold and silver, one would suppose Wakley believed they grew in our pine trees and paved the streets of our cities . . . " At the time of the founding of the *Maryland Medical Recorder* Wakley dismissed it curtly as "a publication recently started,

and the existence of which will not probably be of very long duration . . . "

In 1835, the *Boston Medical and Surgical Journal* took the opportunity to comment on British medical education by saying: "Dublin University has a board of faculty that are a corporation of perfect spongers . . . , George Allman is a coarse, morose, forbidding medical despot, and England appears to be infested with as many ignorant professional pretenders as any nation on the globe. . . . " Later Dowler, editor of the *New Orleans Medical and Surgical Journal* complained: "Our British brethren are not very indulgent toward us. They blame us because we are deficient in originality and yet when we have the good luck to strike on a vein a little novel, they straightaway claim it for themselves . . . "

Once more in 1870 the controversy was vigorously revived when the *London Medical Times and Gazette* remarked that: " . . . in America . . . the medical newspaper exists only in the most rudimentary form . . . One editor apologized for the nonappearance of his journal one month by publicly announcing that he had had no time to attend to it. On another occasion the same individual accounted for a lot of blunders by the fact that he was off for a holiday when the journal was going through the press. What would our readers say were we to treat them thus?" The editor of the *Nashville Journal of Medicine*

and Surgery attempted a rebuttal by means of high-flown classical and allegorical phrases to which the Britisher acidly replied: "We are fain to confess that we do not understand the American language, but are obliged to content ourselves with plain English. . . . "

As the rancor died down in the 1880's, an American editor remarked, " . . . our Texas brethren are to be congratulated that their great state has at last been recognized by the haughty and arrogant Briton, a writer in the British Medical Journal having actually condescended to quote from the Transactions of the Texas State Medical Association."

By 1900, the bitter contention passed away for America had achieved medical greatness and its works were widely acknowledged. Moreover, the appointment of America's Osler to the Regius Professorship of Medicine at Oxford in 1905 stilled the remaining jealousies. Insolence, truculence, bitterness, and bombast very properly disappeared from English and American medical editors and they soon forgot that their forebears had suffered fights of the intensity of a family feud.

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WALTER G. STUCK

Original Articles

TIBIAL DEFECTS WITH NONUNION TREATED BY TRANSFERENCE OF THE FIBULA AND TIBIOFIBULAR FUSION

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ROCHESTER, MINNESOTA

PROLONGED disability due to tibial defects with nonunion creates an economic and social problem which brings the patient to the orthopedic surgeon with the hope of avoiding amputation and obtaining a functioning limb. Fortunately, modern reconstructive surgery offers the means whereby the ununited and often infected tibia may be fused with the fibula, thus permitting subsequent usefulness and weight bearing.[1,2] In our experience these patients have usually had repeated surgical procedures and have been disabled for several years. Needless to say, their financial resources have become quite limited. Since the surgeon who is confronted with such problems knows the difficulty in obtaining union in these cases, he is often tempted to resort to amputation as a solution. We desire to report our experience in fifteen cases of nonunion with defect of the tibia treated by means of fibular transference and tibiofibular fusion.

The procedure which insures such a use of the fibula is popularly referred to in this country as the Huntington-Stone operation and is usually carried out in two stages. Huntington, in 1905, reported a case of osteomyelitis of the tibia with great loss of substance in which he had transferred the fibular shaft into the upper and lower tibial fragments with good results. In 1907, Stone carried out a similar procedure on a six year old boy for the same reason and with the same satisfactory result. There were some differences in the technic and the handling

of the cases after operation but the surgical principles employed were the same in the two cases. Huntington transferred the osteotomized fibular ends into intramedullary cups prepared in the tibial fragments, whereas Stone cut steps in the fragments of his case and fixed them in an interlocked apposition held tightly by means of the tibial periosteum which he had been careful to preserve for covering. Both authors transferred the lower portion of the fibula at a second-stage operation. Huntington, from the experience gained, pointed out that one should not allow weight bearing between operative stages because such a course would result in disalinement of the ankle mortise with vulgus deformity of the foot, as it did in his case.

Although Huntington and Stone were the first to record in this country cases in which transference of the fibula was carried out for the purpose named, they were by no means the first to conceive such a procedure and to use it. In 1884, E. Hahn reported a case of ununited fracture of the tibia with loss of part of the tibial shaft in which he had transferred a portion of the fibula after osteotomy into the proximal tibial fragment leaving the lower portion of the fibula intact. His result was apparently successful, but he made mention that weight bearing would have perhaps been better if the lower portion of the fibula had also been transferred. Codivilla subsequently perfected the two-stage technic

preceding Huntington and Stone by several years.

One of us (H. W. M.) has been for some
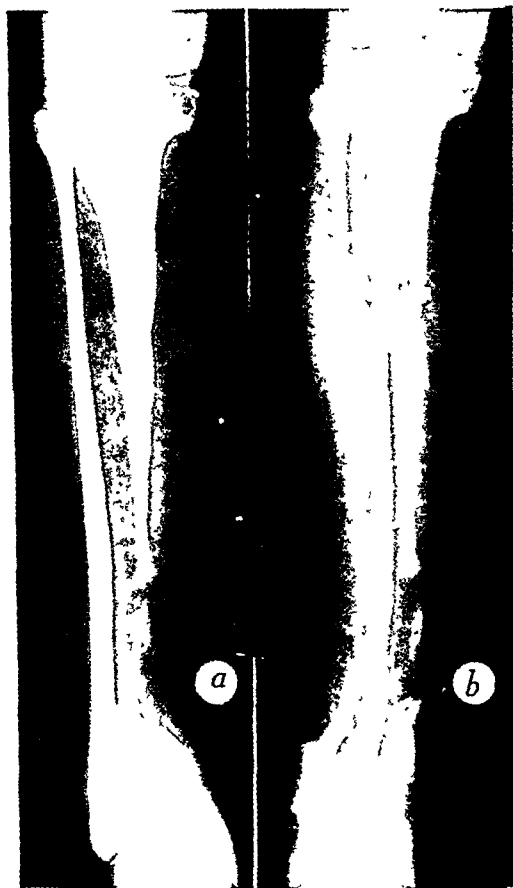
FIG. 1. a, Ununited fracture of the right tibia with loss of substance of the shaft before surgical stabilization; b, following osteotomy and transference of the fibula at the upper and lower ends.

time using a devised modification of the Huntington-Stone procedure in certain selected cases. This modification employs the use of the fibula without osteotomy and transference simply by arthrodesis of the upper and lower tibiofibular joints. The advantage over the original technic is threefold: first, the entire blood supply to the shaft of the fibula is left intact; second, the surgical approaches are usually without the field of infection if the latter is present, thus reducing the risk of spreading the infection and allowing operation earlier than if the older technic is used; and third, if the surgeon desires to fuse the tibial fragments with a tibial graft, the modified

procedure will afford stabilization and insure greater immobilization without interference in the grafting field. We believe this internal fixation with the fibula is an important factor in obtaining fusion of the tibia. In certain other cases, we have been using a modified combined procedure in which the upper tibiofibular joint is ankylosed and the lower portion of the fibular shaft is osteotomized and transferred in a somewhat similar manner to the second-stage Huntington-Stone operation. These procedures will be outlined in detail later on.

CLINICAL DATA

In this report we wish to present a total of fifteen cases in which some type of fibular stabilization or transplantation was performed. (Tables I and II.) All had been seen over a period of years from 1914 through 1939 because of nonunion of the shaft of the tibia with moderate to great loss in the diaphysis. In five cases the deformity had resulted from hematogenous osteomyelitis, in nine from fractures and in one from pathologic fracture following osteomyelitis. One or more sequestrectomies had been performed before admission on all of the patients who had had hematogenous osteomyelitis. In one case tibial bone grafting had been attempted with failure. Six of the nine fracture cases had suffered compound wounds at the time of the original injury, three having received shotgun wounds. In two of the nine secondary osteomyelitis had developed following therapeutic measures. Four of the nine fracture cases had been subjected to bone grafting procedures without success; in one case grafting was attempted twice. Altogether six of the nine patients had had open operations of some type in an attempt to obtain union.

Eight of the fifteen patients were male and seven female, the youngest being seven years, the oldest thirty-three years and the average twenty-two years. The average time for the duration of symptoms before being treated here was four years and eight

months, the shortest period being seven months and the longest nineteen years.

The types of procedures employed and the number of cases of each may be out-

both the upper and the lower ends were transferred, on three the upper end only, and on one the lower end only); (2) modified (Meyerding) operation—performed on

TABLE I
CASES OF FIBULAR OSTEOTOMY AND TRANSPLANTATION (HUNTINGTON)

Case	Age, Years; Sex	Occupation	Cause of Deformity	Duration	Region Involved	Type of Procedure Here	Complications	Results and Remarks
1	19 F	Farm girl	Osteomyelitis; sequestrectomy elsewhere	7 years	Right tibia	Upper and lower transplantation	None	Good
2	22 F	Housewife	Fracture; subsequent infection; nonunion	5 years	Left tibia	Upper and lower transplantation	Fell, fractured fibula 2 years later; finally ok.	Good*
3	28 F	Housewife	Shotgun wound; considerable drainage	7 months	Left tibia	Upper transplantation	Recurrent osteomyelitis; amputation after 5 yrs.	Operation good
4	15 F	Student	Shotgun wound; open reduction and bone graft	2 years	Right tibia	Upper transplantation	None	Good*
5	20 M	Barber	Osteomyelitis; sequestrectomy elsewhere	7 years	Left tibia and knee joint	Lower transplantation	Fragments slipped; reoperation	Good
6	9 M	None	Osteomyelitis; 3 sequestrectomies elsewhere	7 months	Right tibia	Upper and lower transplantation	Upper fragments slipped; reoperation	Good†
7	12 F	School child	Osteomyelitis; 3 sequestrectomies elsewhere	3½ years	Left tibia	Sequestrectomy and later bone graft; upper and lower transplantation	Bone graft absorbed, resorted to fibular transplantation	Good
8	33 F	Housewife	Osteomyelitis; later fracture	19 years	Left tibia	Upper transplantation	1. 3 subsequent sequestrectomies; 2. Removal head fibula for peroneal palsy	Good‡

* Pre-existing synosteosis lower tibia and fibula.
† Retardation epiphyseal growth.
‡ Good result with malposition. Pre-existing synosteosis lower tibia and fibula.

lined as follows: (1) Osteotomy and transference—carried out on eight patients in whom one or both ends of the osteotomized fibula were transferred by implantation or notching into the tibial fragments (on four

three patients in whom both upper and lower tibiofibular articulations were ankylosed; (3) modified combined (Meyerding) operation—carried out on three patients in whom the upper tibiofibular joint was

ankylosed and the lower end of the fibula transferred to the distal tibial fragment after osteotomy (osteotomy was not neces-

carried out on one patient in whom a portion of the shaft of the fibula was completely excised from its bed and trans-

TABLE II
CASES IN WHICH MODIFIED PROCEDURES WERE PERFORMED

Case	Age, Years, Sex	Occupation	Cause of Deformity	Duration	Region Involved	Type of Procedure Here	Complications	Results and Remarks
				Tibiofibular fusion				
9	25 M	Truck driver	Compound fracture; previous open reduction	8 mos.	Right tibia	1. Upper and lower fusions; 2. Later reversible tibial graft	None	Good
10	27 M	Physician	Fracture and nonunion; bone graft elsewhere; osteomyelitis	6 yrs.	Right tibia	Upper and lower fusions following 2 sequestrectomies	Temporary peroneal nerve palsy	Good. Some malposition
11	25 M	?	Bilateral tibial fracture with osteomyelitis	9 mos.	Right and left tibia	Upper and lower fusions on right, subsequent sequestrectomies	Chronic drainage	Too early to predict. Still has nonunion
				Combined fusion and osteotomy				
12	23 M	Farmer	Shotgun wound; graft attempted elsewhere	5 yrs.	Right tibia	Upper fusion; lower osteotomy and fusion	Temporary peroneal nerve palsy	Good
13	7 M	None	Osteomyelitis; sequestrectomy and bone graft elsewhere	4 yrs.	Right tibia	Upper fusion; lower osteotomy and fusion	None	Good
14	34 M	Service station	Compound fracture; sequestrectomies elsewhere	19 mos.	Left tibia	Upper and lower fusion	None	Good. Osteotomy not necessary because previous fibular fracture
				Fibular graft same leg				
15	21 F	?	Fracture; open reduction and bone grafts elsewhere	7 yrs.	Left tibia	Excision portion fibula, same leg and grafting	None	Good

sary in one case because the fibular shaft was already in a suitable position for synosteosis as a result of previous fracture), and (4) fibular graft in the same leg—

planted as an ordinary autogenous graft. (Figs. 1, 2 and 3.)

The complications arising following the various procedures may be noted in Tables

I, II and III. In three cases, temporary palsy of the peroneal nerve resulted from transplantation or stabilization of the

ture united and a useful limb was finally obtained.

The results in all fifteen cases, regardless
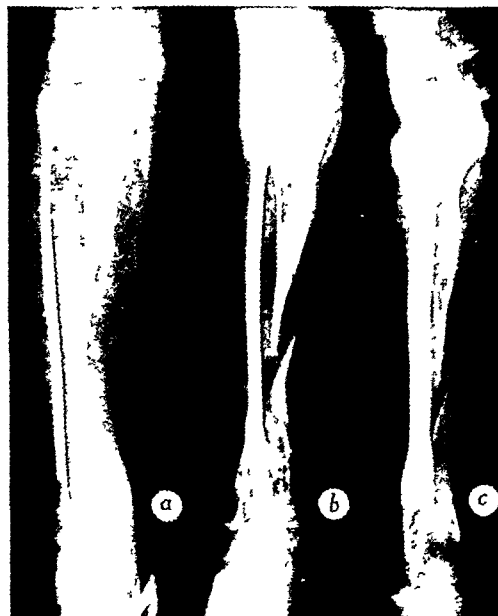

FIG. 2. *a*, Ununited fracture of the right tibia with loss of substance of the shaft before surgical stabilization, also fracture of fibula; *b*, following tibiofibular fusion and reversible bone graft with good result.

upper portion of the fibula. In two of the cases, the palsy disappeared during conservative treatment, while in the third, excision of the remaining fibular head was necessary before function returned.

It is to be noted that in five cases recurrent drainage occurred from pre-existing osteomyelitis. In the case of one woman subsequent amputation was performed elsewhere because of chronic drainage in spite of fibular stabilization which had given a satisfactory weight-bearing limb for about four years. The transferred fibular fragment slipped in two cases following operation and reoperation was done. The final result in each case was good, although in one there was a disturbance in the epiphyseal growth which later gave rise to shortening of the affected limb.

Two years following successful two-stage fibular transplantation, a patient fell and fractured the transferred bone. The frac-

of the type of procedure used, may be classified as generally good. By good, we mean a limb which could eventually withstand weight bearing without support. Continued use of elevated shoes and braces was necessary in a few cases because of shortening and the desire for added protection. It has already been mentioned that amputation was later done on one patient because of drainage. The lapse of time since operation has been too short in two cases to allow proper evaluation of the results; fusion of the tibia and fibula has been obtained and the indications are that useful limbs will eventually be obtained. In one of these cases, the tibia of the opposite leg suffered a compound fracture which resulted in nonunion despite repeated operation and fibular stabilization is under consideration.

In one case in which arthrodesis of the upper and lower tibiofibular joints was

done, subsequent tibial (reversible) bone grafting was performed and the result has been satisfactory, as shown in Figure 2a and b.

FIG. 3. a, Gunshot wound through tibia with nonunion and loss of substance of the shaft before surgical stabilization; b, following arthrodesis of the upper tibiofibular joint and osteotomy with transference of the lower fibular shaft into the tibia.

The results according to types of operative procedures used may be found outlined in Table II.

OUTLINE OF THE MODIFIED OPERATIVE PROCEDURES

Modified (Meyerding) (Tibiofibular Fusion). After the limb has been prepared and the tourniquet applied, an antero-lateral incision is made over the head of the fibula extending some 3 inches (8 cm.) over the groove between the tibia and fibula. Special care is taken to avoid traumatizing the peroneal nerve which should lie posterior to the line of incision. The safest measure is to locate this structure and isolate it from the operative field. It is retracted lightly in order to avoid pressure

neuritis. The ligaments, cartilage and periosteum are removed from between the two bones with curet and chisel. The underlying bone should be thoroughly

FIG. 4. a, Ununited fracture of the right tibia with loss of substance of the shaft before surgical stabilization; b, one year following arthrodesis of the upper tibiofibular joint and transference of the lower end of the fibula into the tibia; c, same extremity five years after operation; note hypertrophy of fibular shaft.

roughened wherever the surfaces contact. Drilling into the marrow cavity may hasten synosteosis. As a usual thing, internal fixation with foreign materials will not be necessary, but either a vitalium or beef-bone screw may be used if the surgeon desires. The incision is closed layer by layer in the usual manner.

The lower tibiofibular articulation may be ankylosed at the same time or this may be done at a second operation. If it is to be done immediately, the tourniquet should be released temporarily after dressing the wound before one proceeds with the second stage. An anterolateral incision is also made over the external malleolus and the underlying tissues are retracted mesially. The same roughening, drilling and impaction are made as in arthrodesis of the upper articulation. After the incision is tightly closed, a plaster of paris cast is applied

extending from the toes to above the mid-thigh. The knee is held in slight flexion and the foot at a right angle. Canvas straps

this procedure is more extensive in nature and requires a longer time for execution, it is safest to do it in two different operative

TABLE III
RESULTS AND COMPLICATIONS COMPARED

Type of Procedure		No. of Cases	Results		Complications	Remarks
			Good	Poor		
1. Osteotomy and transference into prepared bed or notch	Both ends	4	4	0	1 upper fragments slipped, 2nd operation necessary; 1 fractured transferred fibula 2 years later	Union occurred
	Upper only	3*	3	0	1 subsequent amputation for drainage and disability; 1 peroneal palsy requiring excision fibular head	
	Lower only	1	1	0	1 fragments slipped, 2nd operation necessary	
	Total	8	8	0		
2. Modified fusion (upper and lower tibiofibular articulations)		3	1	0	1 temporary peroneal palsy	Too early to estimate results in 2 cases although firm union has occurred at sites of arthrodeses. Good result in case which had reversible tibial graft following fibular operation
3. Modified-combined (fusion upper tibiofibular joint and osteotomy with side to side transference lower fibula)	With osteotomy	2	2	0	1 temporary peroneal palsy	
	Without operative osteotomy†	1	1	0		
	Total	3	3	0		
4. Fibular graft same leg (complete excision of portion of fibula)		1	1	0		
Total.............		15	13‡	0		

* Lower not transferred because bony synosteosis had occurred in three cases between lower fibula and distal tibial fragment due to fracture and infection.
† Osteotomy not necessary in one case because of previous fracture to fibula.
‡ Too early to estimate in two cases.

may be incorporated into the cast to allow elevation of the limb.

Modified-Combined (*Meyerding*). Since

stages. The first stage is carried out on the upper tibiofibular articulation in the same manner as in the foregoing procedure.

In the lower end an incision is made along the course of the fibula extending from the ankle joint up about 4 inches (10 cm.). The length of exposure will depend on how high up the shaft the osteotomy of the fibula will be made and this in turn will depend on the length of the lower tibial fragment together with the absence or presence of infection. In carrying the incision down to the bone, care should be taken to avoid the superficial peroneal nerve and the tendons in this region. The anterior peroneal artery may give rise to troublesome bleeding if severed. The interosseous membrane between the tibia and the fibula is cleanly dissected out from the lower articulation to about 2 inches (5 cm.) above the elected site of osteotomy. The ligaments and periosteum are denuded and a bed is prepared on each bone for side-to-side synosteosis. Osteotomy is performed in greenstick fashion or transversely usually about 3 inches (8 cm.) above the ankle and the opposing fragments are impacted together. Multiple drill holes may aid in osteogenesis. Either a screw or a Parham band may be utilized for purposes of stabilization. The wound is closed in the usual manner and a cast is applied.

COMMENT

It is obvious from the results that a fairly substantial limb can be reconstructed by means of fibular transference or tibiofibular fusion. The period of immobilization will depend on the individual case but the usual period between the date of the second-stage operation and the time when weight bearing is allowed will vary on an average of from six months to one year. Weight bearing should be started with some type of support, either a walking cast or a caliper brace. Later a light weight brace extending from the knee down will often suffice. External fixation should be employed until, in the opinion of the surgeon, the roentgenologic and clinical appearance indicate that union is sufficiently strong to stand the stress and strain to which a lower extremity is normally subjected. As can be seen in Figure 4a, b and c, the fibula will

become hypertrophied during weight bearing to a degree often approaching the size of the replaced tibia. However, in some patients this hypertrophy is much slower than in others and they will consequently need support for a longer period. As exemplified in one of our cases, the risk of fracture to the fibula is quite possible.

The choice of procedure will depend on the individual case. The merits of the modified operation have already been mentioned. It does not result in providing a direct weight-bearing line such as one can obtain with osteotomy and transplantation, but this disadvantage is by no means a serious one. The modified combined procedure somewhat eliminates this disadvantage and for all practical purposes should serve well. It is to be stated again that if one wishes to stay clear of an infected field or resort to tibial grafting as a third-stage procedure, the simple modified procedure has its technical advantages.

SUMMARY

The use of the fibula for purposes of stabilization in the same leg was found to be indicated in patients with tibial nonunion and associated wide defects and long-standing infections. Two modified operative procedures, employing tibiofibular fusion without osteotomy, were used in six cases. A total of fifteen cases and the results in each are presented in which some type of fibular stabilization was performed with known good results in thirteen cases (86.7 per cent).

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FRACTURES OF THE RIBS

A REVIEW OF 386 CASES

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SHREVEPORT, LOUISIANA

FRACTURES of the ribs constitute one of the commonest lesions in medical literature. In most instances they are regarded as rather benign but, due to their proximity to underlying vital organs and structures, any complication tends necessarily to become a serious one. Consequently, their interest is manifested continuously by the general practitioner, the roentgenologist, the industrial surgeon and the thoracic surgeon. It is the purpose of this article to call attention to some of the past statistics and contribute an additional series of cases which has made up the material for this particular study.

During the past three decades there have been many interesting comprehensive reports relating large series of cases. In 1910, Ziegler analyzed a series of 820 cases of rib fracture showing that the mortality in the series occurred only in the group presenting lung complications.

Ziegler	Total	Recovered	Invalidated	Dead
Fractures without complications............	756	753	3	0
Fractures with pleural complications.........	38	35	3	0
Fractures with lung complications............	26	17	2	.7

This fact was corroborated by Haubensak in 1923 who reviewed the fractures of the ribs occurring in 1156 Swiss workers. Those with pleural and lung complications represented 13 per cent of the total number of cases. These complications were more specifically designated as pneumonitis in eighteen, subcutaneous emphysema

in thirty-one, hemothorax in twenty-four, lung trauma with hemoptysis in twenty-four, pneumothorax in fifteen and tuberculosis in four.

Haubensak	Total	Recovered	Invalidated	Dead
Fractures without complications............	990	989	1	0
Fractures with pleural complications.........	56	56	0	0
Fractures with lung complications............	51	30	7	14

Maragliano, in 1913, reviewed 1,528 thoracic injuries with 572 rib fractures in a study of 18,000 war injuries. Of the rib fractures 161 involved only one rib, 294 involved from two to five ribs, and 117 had more than five ribs involved. Only three of these cases had fractures of the costal cartilages. Of his list of complications there was local pleuritis in eight, costophrenic pleuritis in twenty-four hemothorax in six, pneumothorax in three, subcutaneous emphysema in three, traumatic pleuritis in four, traumatic lesions of the lungs in fifteen, traumatic tuberculosis in one and no instance of traumatic pneumonitis.

Bistolfi in 1930 reviewed 200 cases of thoracic injury showing the relation of age to frequency of lung and pleural complications and to displacement of the fragments.

Bistolfi	Per Cent
Those under 40 years without complication or fracture.....................	68
With fracture............................	32
With complication and fracture..........	1
Those over 40 years without complication or fracture....................	45
With fracture............................	55
With complication and fracture..........	5

405

	Cases
Those under 40 years (32 cases) with displacement of fragments	1
Without displacement of fragments	31
Those over 40 years (55 cases) with displacement of fragments	21
Without displacement of fragments	34

More recently, Findlay, in analyzing the injuries admitted at the Beekman Street Hospital through a ten-year period, recovered 551 instances of rib fracture. The mortality of the group was 24.5 per cent, three-fourths of which had other fractures and dislocations.

Fractures of the first rib have received special consideration in the reports of Breslin, Oldfield and Weldon. Collected cases of spontaneous fracture have been reported by Gurlt, Stimson, Richardson and Oechsli. Others have reported rib fracture occurring during parturition and in the insane. Moreover, the literature is abounds with case reports exhibiting such complications as subcutaneous emphysema, mediastinal emphysema, paradoxical respiration, pulmonary abscess, adynamic ileus and hemorrhage from a tear of the subclavian artery. There are likewise many contributions to the therapy of rib fractures with particular reference to the type of strapping, novocain injection and technic of rib resection.

TABLE I
CAUSES OF FRACTURE (ALL FRACTURES)

	No. of Cases		No of Cases
Fall	108	Muscle pull	5
Auto passenger	96	Cough	57
Struck by auto	57	Pathological	11
Local trauma	37	Unknown	51
Gunshot	3		

This report comprises a study of 386 cases of rib fracture admitted to the University Hospital from July 1, 1934, to January 1, 1940. Of this group 278 were male and 108 female. There was a total of 917 ribs fractured or an average of 2.4 ribs per patient. Table 1 shows a list of the causes, those associated with fall and auto

injuries leading the list. Interestingly enough, three were due to operative trauma in which forceful retraction against the rib in an empyema, thoracoplasty and nephrectomy respectively caused a fracture. Fourteen of the patients who were subjected to a fall were victims of insanity or epilepsy.

TABLE II
SYMPTOMS AND SIGNS (ALL FRACTURES)

	No. of Cases		No. of Cases
Pain	255	Crepitus	13
Tenderness	181	Regional anesthesia	5
Deformity	44		
Limitation of motion	22	Paradoxical motion	2
Unconsciousness	18	Wheezing	2
Dyspnea	17	Unknown	59
Hemoptysis	13	None	46

Those patients having symptoms and signs (Table II) exhibited pain and tenderness predominantly in 255 and 181 instances, respectively. A conspicuous group are eighteen of those showing no symptoms or signs due to unconsciousness, and five with anesthesia due to transverse myelitis. Strikingly enough, there were thirteen patients who had hemoptysis which would infer that the lung had been perforated by the trauma or that bleeding from a chronic lesion had been precipitated. Crepitus was elicited only thirteen times while the signs of inspection, namely, deformity, limitation of motion and dyspnea, were present forty-four, twenty-two, and seventeen times, respectively.

Early cases or acute fractures were considered as those seen before normal rib healing is complete, or four weeks, since many patients were admitted during the latter part of that interval for complications which developed as a result of their fractures. The early fractures totaled 149, but the observer will note that ninety-two were seen during the first seventy-two hours. All of the group of fractures of unknown duration were healed on admission

which excludes them definitely from consideration with the acute category. (Table III.)

TABLE III
TIME SEEN AFTER FRACTURE (ALL FRACTURES)

	No. of Cases		No. of Cases
First 24 hours......	69	From 1 to 4 months.........	36
Second day........	13		
Third day.........	10	From 4 to 12 months........	23
From 4th to 7th day	16		
Second week.......	20	Over 1 year......	129
From 2nd to 4th week...........	21	Unknown........	58

TABLE IV
AGE BY DECADES (ALL FRACTURES)

Decade..	0–9	10–19	20–29	30–39	40–49	50–59	60–60	70–79	80–89
Cases....	3	14	36	46	67	96	82	35	7

The ages in the whole series varied from birth to eighty-seven years. (Table IV.) The majority of fractures in both acute and chronic cases were in the fifth and sixth

The mortality takes into account only those patients succumbing due to complications directly related to the rib fracture. The average number of ribs fractured is rather constant for different age groups and is no higher than the gross series. There is a conspicuous tendency for the diaphragm to rise in the fifth and sixth decades, more so than in the other age groups.

The location of the fracture (Table VI) must be considered from several aspects: first, the rib region involved. Here it will be noted that ribs have been grouped conveniently into regions comprising two or three ribs with the exception of the first rib. There is also a designation for the right and left side. Lastly, it is important to ascertain which portion of the rib region is involved, whether it be near the spine or near the costal cartilage. Diagrammatically (Fig. 1), it may be observed that there are certain prominent areas of the thorax which are exposed to trauma. In this series, the posterior and posterolateral portions of the thoracic cage were most frequently

TABLE V
ACUTE FRACTURES (BY DECADES)

Age	No.	Male	Female	Aver. No. Ribs	Multip. Ribs	Angulated Overriding Comminuted	Diaphragm Rise Per cent	Mortality Per cent
0–9	1*	1	0	14	0	0	0 (0)	0 (0)
10–19	7	4	3	2.1	0	2	0 (0)	1 (14.5)
20–29	22	14	8	2.9	3	2	3 (13.6)	1 (4.8)
30–39	26	13	13	2.9	2	6	2 (7.7)	2 (7.7)
40–49	30	20	10	2.7	1	7	3 (10.0)	0 (0.0)
50–59	29	23	6	2.1	1	7	6 (20.7)	2 (6.9)
60–69	21	13	8	2.7	0	6	7 (33.3)	2 (9.5)
70–79	11	8	3	2.4	2	3	1 (9.1)	1 (9.1)
80–89	2	1	1	3.5	0	2	0 (0.0)	2 (100)

* Osteogenesis imperfecta—fracture during birth.

decades, while in the acute group alone, the majority occur in the third, fourth and fifth decades. (Table V.) This latter consideration shows the relation of age in the recent fractures to sex, average number of ribs per patient, number of ribs with multiple fractures, complex position of fragments, rise of the diaphragm and mortality.

involved and the fifth to the tenth ribs were predominant in the other dimension. It is interesting to note that the anterolateral and axillary portions of the first rib are most frequently involved here.

Complications to skin occurred twenty-one times in the acute fractures. These were laceration or penetrating wounds in

four, gross hematoma in five, subcutaneous emphysema in ten, hematoma with deep chest wall abscess in one and hematoma with subcutaneous emphysema in one.

one, empyema in one, gross unilateral effusion in fifteen, bilateral effusion in one, and minimal local or costophrenic pleuritis in six. The fifteen cases of effusion included
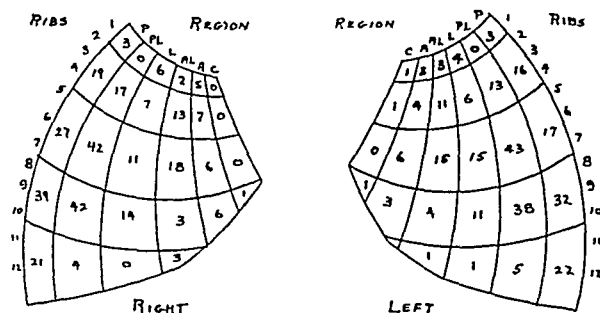
FIG. 1. Regions involved in rib fractures. C, cartilage; A, anterior; AL, anterolateral; L, lateral; PL, postero-lateral; P, posterior.

TABLE VI
LOCATION OF FRACTURES (ALL FRACTURES)

Ribs	Right					Left				
	1	2-3-4	5-6-7	8-9-10	11-12	1	2-3-4	5-6-7	8-9-10	11-12
Costal cartilage	0	0	0	1	0	1	1	0	1	0
Anterior ..	5	7	6	6	0	3	4	6	3	0
Anterolateral	2	13	18	3	3	3	11	15	4	1
Lateral .	6	7	11	14	0	4	6	15	11	1
Posterolateral	0	11	42	42	4	0	13	43	38	5
Posterior	3	19	27	39	21	3	16	17	32	22
Multiple	0	3	6	4	0	1	3	2	6	0
Total ..	16	60	110	109	28	15	54	98	95	20

TABLE VII
COMPLICATIONS (RELATION TO AGE AND SEX)

Sex and Decade	Male	Female	0	1	2	3	4	5	6	7	8	Total
Skin complications	16	5	0	3	5	1	3	3	4	1	1	21
Pleural complications	31	8	0	4	7	7	6	6	7	1	1	39
Lung complications	25	9	0	3	9	4	7	4	4	3	2	34
Rise of diaphragm	22	7	0	1	7	4	6	4	4	2	1	29
Bone complications	4	7	0	0	2	2	1	1	4	1	0	11
Severe traumatic shock	6	1	0	0	1	2	0	0	2	0	0	7
No complications	44	35	1	3	10	15	18	19	8	5	0	79

Complications to pleura were present in 39 of the acute cases. There was simple unilateral pneumothorax in five, tension pneumothorax in three, hemopneumothorax in four, tension hemopneumothorax in

three patients with hemothorax proved by aspiration.

There were thirty-four cases presenting lung complications following recent fractures. These were representative of atelec-

tasis in two, pneumonia or pneumonitis in twenty-four, laceration of the lung in six and pleuropulmonary fistula in one.

There were no mediastinal complications in this series, nor were there any concomitant injuries to heart, pericardium or esophagus. However, seven of the acute cases presented severe traumatic shock on admission which minimized the importance of their rib fractures in regard to therapy. In the group of old fractures were two patients with diaphragmatic herniae precipitated by the cause of the fracture.

seventh and eighth decades develop complications than those who escape.

A consideration of the region involved to the complication (Table VIII) reveals some interesting facts. Skin and pleural complications occurred predominantly at a higher rib level than the general location of fractures. Moreover, pleural complications occurred twice as frequently on the right side as the left. Skin and pleural complications occur about three to four times as frequently in the anterior, anterolateral and lateral portions of the thorax than the

TABLE VIII
COMPLICATIONS AND OTHER BONES (RELATION TO RIB AND REGION)

Ribs and Region	Aver. No. Ribs	Right					Left					C	An	Al	L	Pl	P
		1	2-3-4	5-6-7	8-9-10	11-12	1	2-3-4	5-6-7	8-9-10	11-12						
(a)																	
Skin complications	3.6	2	6	1	3	1	1	4	3	0	0	0	4	1	6	4	6
Pleural complications	4.0	3	11	5	6	1	2	6	4	1	0	1	3	6	4	15	9
Lung complications	4.0	3	6	4	3	0	2	5	6	5	0	1	1	5	6	9	11
Rise of diaphragm*	4.0	3	11	5	5	1	4	8	6	3	0	0	5	7	8	12	12
Bone complications	4.0	0	6	2	2	1	1	2	5	3	0	1	0	5	4	9	3
(b)																	
Sternum	1.8	2	1	1	3	2	2	1	1	1	0	3	2	5	2	0	4
Right clavicle	4.2	2	6	7	2	1	1	3	0	1	0	0	1	2	1	2	17
Left clavicle	4.4	0	1	1	3	3	2	9	6	5	2	1	1	2	2	7	19
Dorsal vertebrae	3.4	3	6	9	7	5	2	4	2	5	4	0	1	2	2	10	31
Right scapula	3.2	0	3	1	1	0	1	1	2	1	0	0	1	4	0	4	1
Left scapula	4.2	0	1	1	1	0	1	4	2	0	0	0	0	1	2	2	5
Cervical trans. processes	1.0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Dorsal trans. processes	6.0	1	2	2	1	0	0	1	0	0	0	0	0	0	0	1	6

C—costal cartilage. An—anterior. Al—anterolateral. L—lateral. Pl—posterolateral. P—posterior.
* Complicated cases only.

Bone complications occurred only eleven times as a four-week period is a fairly limited span for such complications to occur. These were delayed union in one, nonunion in four, osteomalacia in one, osteomyelitis in two, excessive callus in two and bridging of the ribs in one.

In Table VII these acute complications are studied with relation to age and region of the thorax involved. Generally, it can be seen that as the age advances, there is more likelihood of serious complication. This feature progresses with a gradual reversal of the ratio, in that more patients in the

corresponding general series of fractures. However, the number of skin and pleural complications is about equally distributed from the anterior to the posterior aspect of the rib. Lung complications are likewise more predominant in rib fractures of a higher lever than average, but conform to the general series of fractures in that they predominate in the posterolateral and posterior segments. It is natural to expect relatively few lung complications to occur in fractures of the eleventh and twelfth ribs, most of the latter bones being situated below the level of pulmonary parenchyma.

Bone complications also show a definite tendency to occur more frequently at a higher rib level than the control series, and to follow more anterolateral and axillary fractures than the general distribution of fractures would indicate.

mortality in the complicated series was as follows: skin complications, 23.8 per cent; lung complications, 23.5 per cent; pleural complications, 18.0 per cent; and diaphragm rise in 13.8 per cent.

In regard to the amount of diaphragm

TABLE IX

FRACTURE COMPLICATIONS (RELATION TO POSITION OF FRACTURE, OTHER FRACTURES, AVERAGE NUMBER RIBS, MORTALITY)

	Aver. No. Ribs	Other Frac.		Overriding		Comminuted	Angulated	Other Pos.	Mortality	
		No.	Per Cent	No.	Per Cent				No.	Per Cent
Skin complications	3 6	10	47	7	32 8	2	1	11	5	23 8
Pleural complications	4 0	14	36	13	30	2	1	23	7	18
Lung complications	4 0	11	32	9	26 5	2	3	20	8	23 5
Severe traumatic shock	3 6	3	43	2	29	0	0	5	5	71
Rise of diaphram*	4 0	10	29	9	31	1	2	17	4	13 8
Bone complications	4 0	2	18	3	27 3	1	0	7	0	0
No complications	2 1	11	14	6	7 6	4	1	66	0	0

* Complicated cases only.

In comparing fracture complications with uncomplicated fractures (Table IX), it is apparent that the average number of ribs per patient is approximately twice that of the latter group. Again, it can be seen that overriding of fragments produces complica-

TABLE X
EXTENT OF DIAPHRAGM RISE

	Acute Fractures	All Fractures
Unknown	7	21
None . . .	96	306
Right—1 interspace or less	16	23
1 to 2 interspaces	13	13
2 to 3 interspaces	2	3
Left—1 interspace or less	12	16
1 to 2 interspaces	1	1
2 to 3 interspaces	0	1
Both diaphrams—1 interspace	2	2

tions almost four times as often as none. When other bones are fractured, complications of the skin, lung, pleura and diaphragm rise occur from two to four times as frequently as in uncomplicated cases. The

rise, Table X indicates the extent of this complication. For basis of control figures, the rise of the diaphragm in all fractures, including healed cases is included. Peculiarly enough, the diaphragm on the side opposite the rib fracture was elevated in five cases. This, one may assume to be the result of a contre-coup type of injury. There were twenty-nine cases of acute diaphragmatic elevation exhibiting other complications, viz., to skin, pleura, lung and cardiovascular system. Consequently, two-fifths of the cases in which diaphragmatic rise occurred were indices of other series complications. (Tables VII and VIII.)

An analysis of other bones fractured with rib fractures brings many interesting points to mind. (Table VIIIb and XII.) The sternum was fractured four times, the right clavicle twelve times, left clavicle sixteen times, dorsal vertebrae twenty-two times, right scapula four times, left scapula five times, cervical transverse processes once and dorsal transverse processes twice. The average number of ribs fractured in cases exhibiting other fractures was well above

the control series as will be noted. From the tables, the left clavicle is more prone to complication than the right. Moreover, fractures of the vertebrae carried complications in over half the cases in which they occurred. It is apparent that fractures of

An interesting group are the double fractures of ribs. These occurred in seventeen patients (Table XI) as double breaks in fifteen and as triple fractures in two. The majority of double fractures occurred in the fifth to tenth ribs as in single fractures.

TABLE XI
MULTIPLE FRACTURES (17 PATIENTS)

Rib	Type I Posterior-posterior	Type II Posterior-axillary	Type III Posterior-anterior	Type IV Postero-lateral-anterior	Type V Axillary-anterior	Type VI Posterior-axillary-anterior	Total
Right 1	0	0	0	0	0	0	0
2-3-4	0	0	2	1	3	0	6
5-6-7	0	0	6	0	3	1	10
8-9-10	1	0	6	0	0	1	8
Left 1	0	1	0	0	0	0	1
2-3-4	0	2	1	0	3	0	6
5-6-7	3	0	0	0	0	0	3
8-9-10	1	0	1	0	1	0	3
Total	5	3	16	1	10	2	37

TABLE XII
OTHER FRACTURES (RELATION TO COMPLICATIONS AND MORTALITY)

	No.	Complications						Comminution Overriding Angulation
		Mortality	Skin	Pleura	Lung	Shock	Bone	
Sternum	4	0	2	1	1	0	2	3
Right clavicle	12	0	1	1	2	1	0	2
Left clavicle	16	0	3	6	3	0	4	7
Dorsal vertebra	22	0	11	6	8	1	0	7
Right scapula	4	1	1	3	1	1	0	0
Left scapula	5	0	0	1	0	0	1	4
Cerv. trans. pro	1	0	0	0	0	0	0	0
Dors. trans. pro	2	0	0	0	1	0	0	0

the first rib are frequent with fractures of the clavicles, scapulae and dorsal spine, more so than when none of these bones is fractured. The distribution of ribs fractured on the other hand is not unusual except that there is a tendency for a higher level of fracture corresponding to the side on which the accessory bone was fractured. This can be due to the nature of the injury and direction of the force.

The types of fracture were predominantly (1) posterior and anterolateral (sixteen times) and (2) axillary and anterolateral (ten times). Multiple fractures of the rib did not produce any skin complications but produced pleural complications in four cases, lung complications in five, bone complications in one and elevation of the diaphragm in five, while only two patients exhibited no complications. Other bones

were fractured in four cases in this group. The mortality for all multiple fractures was 5.9 per cent.

TABLE XIII
FRACTURES OF THE FIRST AND TWELFTH RIBS

Causes	1st rib	12th rib
Fall	5	4
Muscle pull	2	2
Auto passenger	13	3
Cough	3	0
Pathological	1	0
Unknown	2	3
Right side	12	6
Left side	10	5
Bilateral	4	1
Alone (no other ribs)	6	8

The first rib was involved twenty-six times in this series. The fracture occurred on the right in twelve, left in ten and bilateral in four. Moreover, this rib was fractured alone on six occasions. Table XIII shows the various causes of first rib fractures. One rib was fractured in two areas.

The twelfth rib was fractured less frequently. There was a total of twelve such fractures, six on the right, five on the left and one bilateral. The twelfth rib was unaccompanied by any other fracture in eight cases. (Table XIII.) One case had a fracture of the first and twelfth ribs along with other fractures, and one tuberculous patient had a bilateral eleventh rib fracture with no other bones involved.

Another interesting group in this series are those due to cough, sneeze or other involuntary effort. (Table XIV.) There were fifty-six such spontaneous fractures and interestingly enough, twenty-four had no symptoms and forty went untreated. Nine were due to tuberculosis, twenty-two to asthma, two to postoperative voluntary cough, five to intrathoracic tumors producing cough, four to pneumonia, six to cardiac cough and four to chronic non-tuberculous pulmonary infections, mainly bronchiectasis. Eighteen of them were seen from the onset and are tabulated as early cases. The average number of ribs fractured per patient was not much over one, but the region involved is characteristic. It will be noted that the anterior, anterolateral and lateral portions are more prone to fracture here, particularly the ribs of the midthorax (5 to 8). Both sides were involved almost equally, the right thirty-six and the left thirty-two.

There were twelve pathological fractures in this series of cases. These were represented as follows: Multiple myeloma in one, bronchogenic carcinoma in one, metastatic hypernephroma in two, metastatic carcinoma of the breast in three, metastatic carcinoma of the parotid in one, neurofibromatosis in one, myelogenous leukemia

TABLE XIV
FRACTURES DUE TO COUGH (RELATION TO RIB REGION)

	No. Early	No. Late	Aver. Rib No.	1	2 3 4	5 6 7	8 9 10	11 12	1	2 3 4	5 6 7	8 9 10	11	12	C ct	A nl	A nt	L at	P ol	P os
						Right					Left						Region		
Tuberculosis	2	7	1 8	0	0	3	2	0	0	1	3	2	1		0	0	2	0	5	5
Bronchial asthma	5	17	1 6	0	0	7	10	1	0	0	5	4	0		0	2	2	2	16	6
Voluntary postoperative cough	2	0	1 0	1	1	0	0	0	0	0	0	0	0		1	1	0	0	0	0
Intrathoracic tumor	3	6	1 3	0	1	1	0	0	0	0	4	5	0		0	0	5	1	4	1
Pneumonia	3	1	1 0	0	1	0	2	0	0	1	0	0	0		0	0	0	0	2	2
Cardiac cough	1	5	1 0	0	0	2	1	0	0	1	2	0	0		0	0	2	1	2	1
Bronchiectasis, etc	2	2	1 8	2	0	1	0	0	1	0	1	1	0		0	0	0	0	4	0	2

in one, osteogenesis imperfecta in one and squamous cell carcinoma of the chest wall in one. There was no special predilection for rib region or portion of a rib involved in any of these. The case of osteogenesis imperfecta was recognized at birth when fourteen ribs were fractured and no complication ensued.

TABLE XV
PATHOLOGICAL FRACTURES

Multiple myeloma	1
Bronchogenic carcinoma	1
Hypernephroma	2
Metastatic carcinoma of breast	3
Of parotid	1
Neurofibromatosis	1
Myelogenous leukemia	1
Osteogenesis imperfecta	1
Squamous cell carcinoma of chest wall	1
Total	12

One is always interested in the positive diagnoses for rib fracture. In this series, fracture was suspected in 163 patients. Other bones were suspected to be fractured and found to be rib fractures in eight. Other diseases were suspected where rib fracture was present eighty-five times, and 130 cases were discovered by routine films.

The therapy administered in all fractures was as follows: unknown in forty-one, none in ninety-one, expectant in 132, strapping of the chest in 108, deep irradiation for pathological fracture in three, and intratracheal suction in four. Three of those subjected to the last named form of therapy had pneumonitis and all survived. The fourth had audible intrabronchial mucus which was regarded as a serious forerunner of pneumonia if not relieved. This mode of therapy has been regarded, therefore, as an effective prophylaxis when bronchial secretions are not effectively raised. Four patients had late excision of the fracture site and intercostal neurectomy for painful rib, and three others had other types of surgery, including biopsy. Nerve injection with novocaine or alcohol was not practiced in this group of cases.

The results of all fractures may be listed as follows: unknown, one; dead from rib fracture, eleven; dead from other causes, fifteen; living and asymptomatic, 326; living with painful rib, sixteen; living, but too soon to evaluate, six; living, but ribs involved with other disease at the time of discharge from the hospital, eight; and living with marked deformity, three.

SUMMARY

A series of 386 rib fractures have been presented which comprise those cases admitted to the University Hospital over a five and one-half-year period. These were studied as to cause, symptoms and signs, and location of fractures. When complication accompanied the fracture the mortality varied from 23 per cent to 71 per cent, while the patients in the uncomplicated group all survived. These complications have been studied in relation to location of fracture, other bones fractured and the average number of ribs involved. There are some interesting groups of cases considered, namely, the spontaneous fractures of ribs, double fractures of ribs and the pathological fractures. A few other large series of case reports of other observers are included in the article for comparison of results.

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A CRITICAL APPRAISAL OF THE LEG LENGTHENING OPERATION

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THE problem of unequal leg length is one that is frequently presented to the orthopedic surgeon. There are four methods in use to overcome the difficulties attendant on the condition:

1. The *first* and simplest is some form of apparatus for elevating the foot of the short leg.

2. *Second*, shortening the well leg by a removal of a portion of bone.

3. *Third*, stopping the growth of the longer leg by destruction of one or more of the epiphyseal lines.

4. *Fourth*, lengthening of the bones of the affected leg.

The first is undoubtedly the least risky yet it is significant that the three surgical methods have been developed in an effort to overcome certain objections to this one. These three surgical approaches to the problem have all been done in enough cases that they may be considered to have been proved entirely feasible.

Our own choice of the lengthening operation was based on the very simple consideration that since all of the surgical methods were open to obvious possibilities of disaster in any individual case, we preferred to work with the leg which was already impaired. In other words we did not want to take the chance of having two bad legs instead of one. Since Abbott published his paper on bone lengthening in 1924 rather numerous cases have been reported by Finkelstein, Carrell, Compere and others.

Most of the papers on the subject have dealt with operative technique to a greater degree than with the end results of the operation. We have felt for some time that a study of the end results of the operation would be timely, and with that in mind we have made an effort to get in touch with our longest standing cases during the past year or two. As this study progressed we found ourselves wondering whether the value to the patient of the results obtained was commensurate with the undoubted difficulty of the operation to both the surgeon and the patient. This led to an attempt to balance one against the other in an appraisal of results as we see them. To state the proposition more baldly, we have attempted to make this paper a scientific study rather than a sales talk for the operation. We may point out that the results we are interested in are not so much the lengthening of the leg as the effect on the gait of the lengthening obtained. We have found definitely that lengthening a short leg does not always improve the gait, and if the gait is not improved the result cannot be counted as good no matter how successful the lengthening may have been. Function must be regarded as the essence of the matter.

The definition of end results needs a little further qualification, in regard to the age of the patient. Most of the bone lengthenings have been done in children. Complete end results in these cases are not to be judged until the child has gone through the period of rapid growth that takes place at adolescence. Some surprises (not to say shocks) may result. In studying our results we have been especially interested in those cases which have passed through this period of rapid growth.

Bone lengthenings have been done in fifty-two cases: nine of the femur; two of the radius; and forty-one of the lower leg. Those of the lower leg are the only ones considered here since the femur offers some-
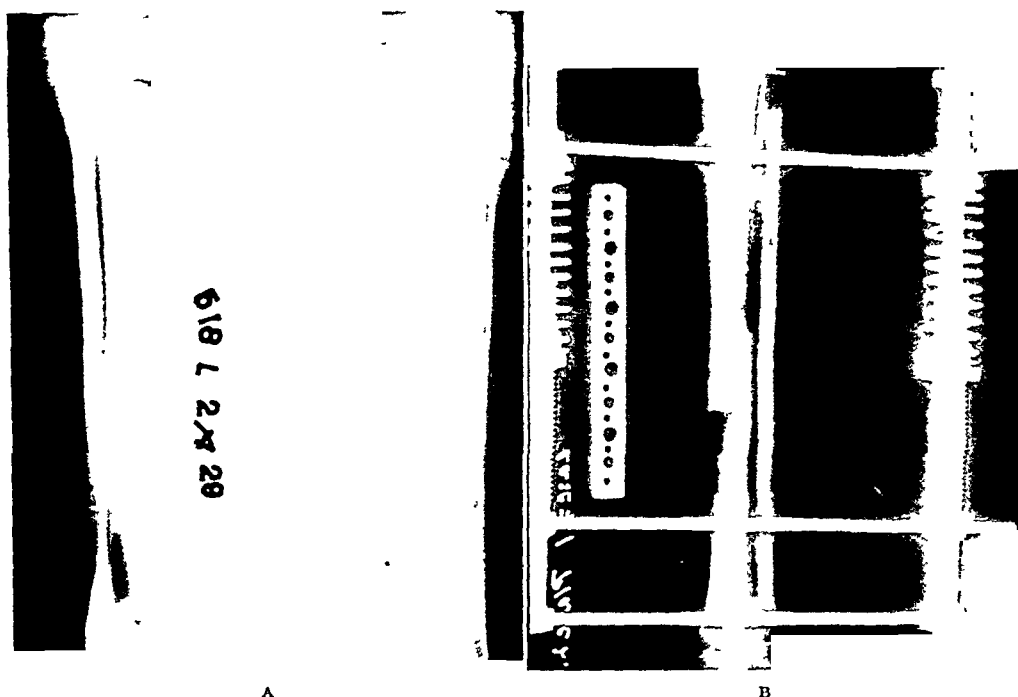
FIG. 1. A, Case 1. Preoperative tibial length ten and one-half inches. B, two months postoperatively. Apparatus in position, lengthening obtained and callus forming; some absorption and irritation around upper pin.
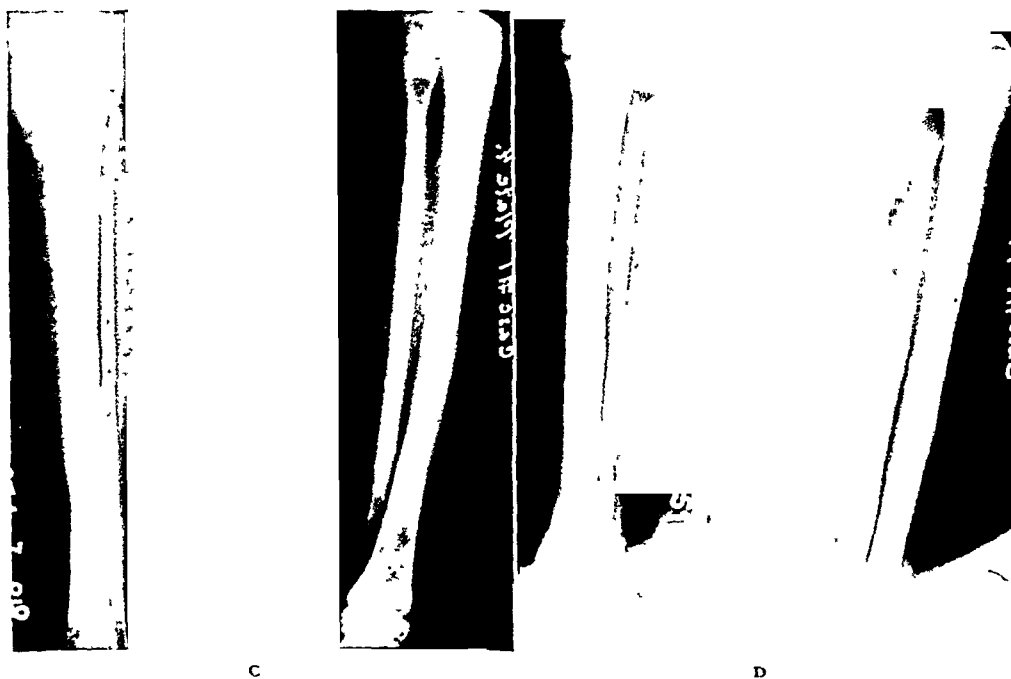
FIG. 1. C. April 20, 1930, one year and two months postoperatively. Medullary canal and cortex well differentiated; pin holes closed. D, May 2-, 1938, nine years and three months postoperatively. Tibia appears practically normal; tibial length now seventeen inches.

what different problems and the two of the radius were special cases.

In the forty-one cases the cause of short-

2 inches and five under. These measurements were made on the x-rays taken from time to time to check the progress and
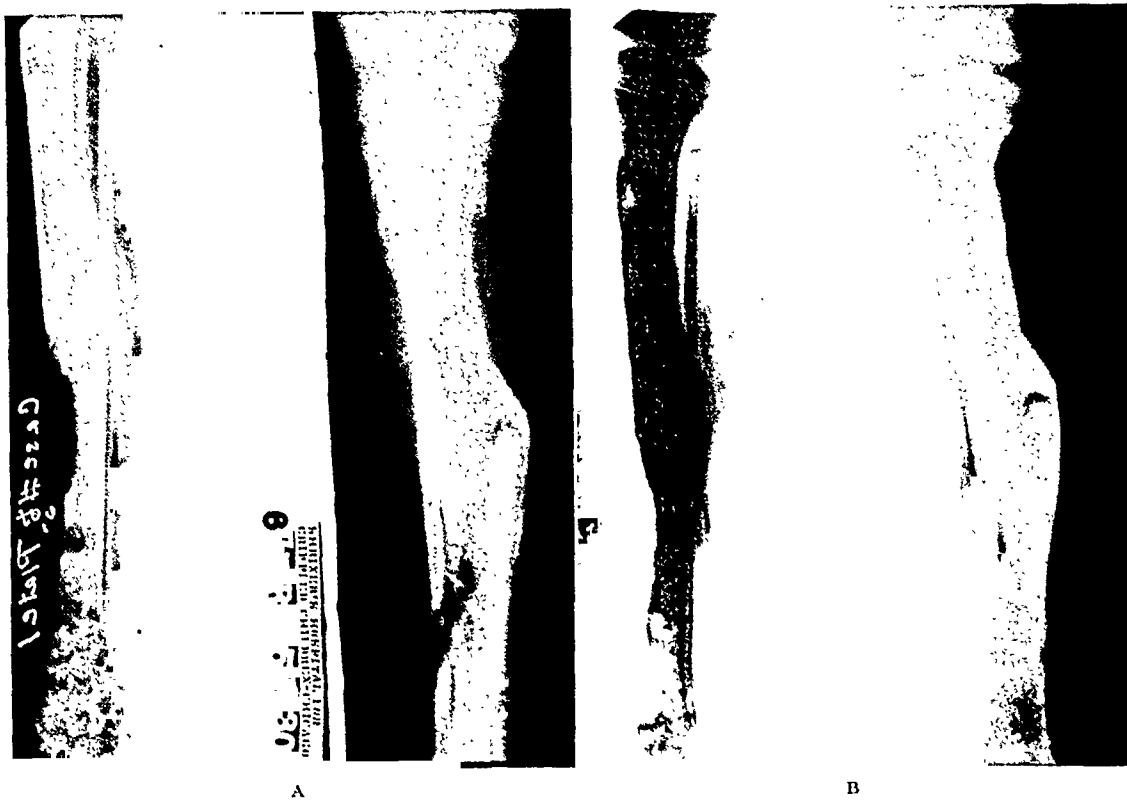
FIG. 2. A, Case v. May 7, 1930, three months postoperatively. Bone infected, but callus forming; fragments displaced; sequestrum forming at upper end of lower fragment. B, July 16, 1930, six and one-half months postoperatively. Bone firmly united in poor position; sequestrum fully formed.

ening was poliomyelitis in thirty-seven. In two other cases the shortening was confined to the tibia and was the result of epiphyseal injury from over-enthusiastic manipulation of club feet. Two cases were congenital shortenings—one with an absence of the fibula and the other a congenital hemiatrophy. The first operation was done in 1929. We have chosen for special study nineteen cases in which operation was done long enough ago for the patient to have passed through the rapid growth of adolescence. We feel they can be fairly considered as end results. This includes all the cases from 1929 to 1934, except for one which was not checked for a five year result. The oldest patient is now 24 years of age and his leg lengthening was done ten years ago. All of this group were poliomyelitis cases.

In this group the lengthening obtained was from 1½ to 2⅞ inches, with five over

precautions were taken against distortion by the divergence of the rays. This accounts for the recording of the figures in eighths of an inch. The group was all checked for five years and some for longer on the following points: first, maintenance of length; second, development of deformities in the leg following the operation; third, changes in muscle power following the operation; fourth, the gait, that is, the function of the leg.

Maintenance of Length. Of the nineteen patients only one has failed to maintain the leg equality even after a growth of several inches in height. In this case one leg was lengthened 2 inches at the age of 12 years. The length was maintained for over a year but in the three following years the patient grew rapidly and the operated leg fell behind 1½ inches. On the other hand in another patient operated on five years ago

the equality was maintained for over a year and then the leg operated on began to forge ahead so that it is now 1½ inches longer
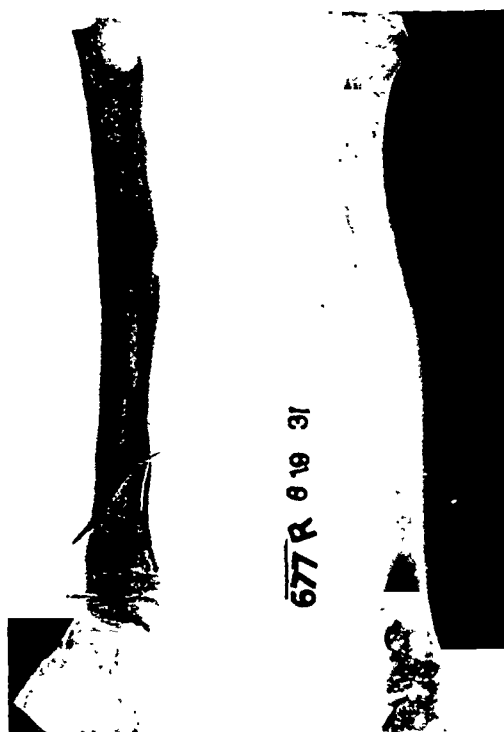
FIG. 2C. June 19, 1931, sixteen and one-half months postoperatively. Sequestrum removed; solid union; medullary canal forming; bone straightening by use; lengthening retained in spite of infection.

than the other. Furthermore the variation is all in the length of the lower leg. In two other cases the operated leg has outgrown its fellow 1 inch, making three cases in which this has happened to a definite extent. The maintenance of length has been quite uniform and a fairly high proportion of the cases (three in nineteen) have shown more rapid growth than the normal leg. This maintenance of the length is somewhat surprising in view of the fact that there does not seem to be anything in the operation itself which would change the underlying conditions which caused the shortening—or more accurately—the de-delayed growth of the affected leg. The factors which cause the delayed growth of the bone are not definitely known.

In our experience shortening in polio-myelitis cases is associated only with severe paralysis. The paralysis may be sharply localized, for instance to the leg below the knee, but it will be of high degree to cause shortening and it must involve a large part of the musculature. I have never seen it, for instance, where only the anterior tibial muscle was affected. These common observations have led to the assumption that delayed growth was due to the lack of circulation associated with the severe muscle paralysis. Some have considered it due to circulatory changes from direct affection of the sympathetic system by the polio-myelitis virus. It may be due to other neurotrophic disturbances, though I believe the physiologists frown on the belief of direct trophic nerves. It may be due to the lack of some normal stimulation to bone growth from the action of muscles attached to the bone. It is difficult to conceive how the lengthening operation could change any of these factors enough to cause the bone to resume growth at a rate equal to its normal fellow. Probably the growth impulse is something considerably more complex than any of the factors we have mentioned.

The three cases in which the lengthened bone outgrew the other leg (and the same thing is happening in other patients not yet old enough to be counted as end results) offer another problem. It is easy to assume that there has been a stimulation to the epiphyseal lines which caused increased growth, but it is difficult to explain its mechanism and why it should continue so long. Furthermore experimental animal work attempting to obtain increased growth through epiphyseal stimulation has not been brilliantly successful. Wu and Wiltner report some experimental work on animals in which they obtained increased growth in long bones by stripping the periosteum, but the increased growth was small and occurred only in a short time after operation. They did not reach any conclusion as to the mechanism by which the lengthening was obtained. The periosteal stripping is done in the bone lengthening operation but the growth apparently

continues for several years. Compere and Adams observed that overgrowth sometimes followed removal of a graft from the

growth took place long after healing was complete and the bone had become quite normal so far as the x-ray appearance was
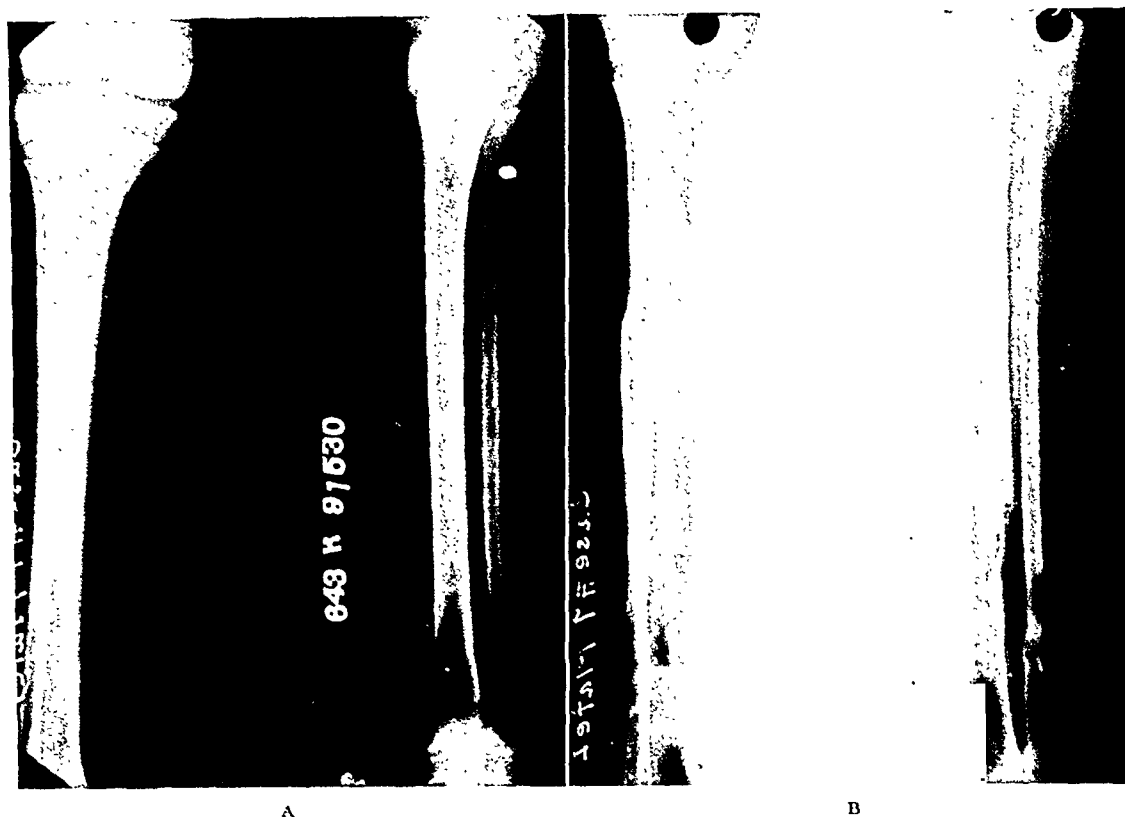
FIG. 3. A, Case IX. Preoperative condition. B, January 7, 1931, three and one-half months postoperatively. Good callus; beginning differentiation of medullary canal.

tibia of a well leg. Their conclusions were that "(1) Minimal trauma to the shaft or the metaphysis of a long bone with or without interruption of the medullary blood supply does not produce any definite increase in rate or extent of longitudinal bone growth. (2) Gross trauma involving a considerable portion of the shaft of a long bone and necessitating repair over a long period of time does produce epiphyseal stimulation and longitudinal overgrowth. (3) The increased rate of growth continues only during the period of healing. (4) This growth stimulation appears to be secondary to the hyperemia and increased vascularity of the bone and soft parts following the trauma and during the process of healing." A leg lengthening operation can be justly classed as gross trauma, thus fitting into Compere's second conclusion. However, the third conclusion does not fit so well. In the three cases mentioned the increase in

concerned and presumably when the circulation was also back to normal. As a matter of fact the mere maintenance of length seems to me to imply a relative overgrowth, inasmuch as the leg had previously dropped behind the normal leg. To be able to control and apply such a stimulus by less drastic means than a leg lengthening operation would be to the advantage of both the patient and the surgeon. At any rate it is an interesting question in the physiology of the bone growth, and we are still following it up. Whatever the difficulty in explaining it, the fact remains that the lengthening obtained has been quite uniformly retained past the adolescent stage of rapid growth. Along with the maintenance of growth there has been, of course, an improvement in posture from the leveling of the pelvis. Also the associated compensatory scoliosis was relieved. So far as the equalization of leg length and its maintenance is concerned

we feel reasonably assured. Some interesting research problems are also opened up for investigation.

FIG. 3C. May 14, 1931, six and one-half months postoperatively. Medullary canal and cortex well differentiated; unusually rapid restoration.

The second point on which these nineteen cases were specifically checked was development of deformities in the leg following lengthening. In this connection we are not considering the deformities that may arise from displacement of the fragments during the lengthening process but rather slowly developing deformities resulting apparently from internal changes in the bones due to the altered mechanics of the lengthened bone. The slight displacement that may occur during the lengthening process disappears, so that usually at the end of a year or at most two, the bone is quite normal in roentgenographic appearance. However, there is a distinct tendency to develop two deformities, a valgus foot and a tibial twist associated with a knock-knee deformity.

In the nineteen cases we are considering, sixteen were badly paralyzed in the affected leg and had already a mild degree of knock-knee deformity. This deformity increased

markedly in eight of the cases and as the weight bearing shifted more to the inner side of the foot, the latter was forced into a valgus position. These patients all had weak hip abductors. Both of these effects we have ascribed to the fact that after leg lengthening a new technique of walking had to be developed. In a sense the leg had been artificialized and the easiest way to use it was to evert the foot and roll the knee in. Wolf's law did the rest. These eight patients also lost a considerable part of the motion of the ankle joint—one of them lost ankle motion completely and it was perhaps this which led to the development of the peculiar gait mentioned, though we believe that the fact that the hip abductors were weak had much to do with it. As we see it, a leg lengthening adds to the strain on the hip abductor group and the resulting gait is an effort to relieve the strain on this group. It is an exaggeration of the gait often developed by patients with weak hip abductors, the result of an effort to move the leg inward under the center of gravity, rather than swaying the body over the leg. In this group of slowly developing deformities we must include one unusual result. One girl of 14 whose leg had been lengthened 2 inches developed a slowly increasing limp after leaving the hospital and walking for several months. It was found that the head of the femur had dislocated completely from the acetabulum which was shallow and poorly formed. Whether the acetabulum had changed its contour following the leg lengthening we do not know, but it was noted previously that the hip was somewhat unstable and the hip abductor group weak. A Schanz osteotomy restored some of the hip stability but, of course, left the leg shorter than the other.

The third point considered in the study is *changes in muscle power following the leg lengthening.* Most of these patients were badly paralyzed and we did not expect that there would be any increase in muscle power as the result of the operation. In that we were not disappointed. But in one case in this series with a fairly good quadriceps

there was a loss of power so that the quadriceps is now graded as poor. Whether this loss is actual or relative on account of the changes in leverage from the increased length of the tibia is not quite clear. Lengthening in this case amounted to approximately one-seventh the length of the tibia or an increase of 14 per cent in the long arm of the lever with a corresponding increase in load. It is quite possible that the quadriceps did not have the reserve power to take care of this extra load. We have had the same thing happen in another patient not yet old enough to be included in this series of end results.

The fourth point of study is the effect of leg lengthening on the gait. We have already mentioned that leg lengthening does not always make the patient walk better—a conclusion which seems perfectly logical and apparent now but which needed some experience, observation and reflection. In checking the gait of the group we have classified the end results as (1) walking better, (2) no better and (3) worse. Six were classed as better, nine as no better and four as worse. These results are nothing to cause overweening pride and we believe they were largely due to failure to recognize the fact that there were two elements in the limp present before operation—the element of muscle weakness and the element of shortening. Perhaps it would be more accurate to say we did not properly evaluate the relative weights of the two elements. To illustrate this point the number of operations each year is of interest. In 1929 there were three; 1930 ten; 1931 none; 1932 one; 1933 two; 1934 four. The thirteen done in 1929 to 1930 accounted for nine of the thirteen results classified as no better or worse. By that time we were beginning to learn by observation to distinguish between a favorable and an unfavorable case and to select our cases more carefully. It was noted that the cases not improved in gait were those with weak quadriceps and hip muscles, particularly the so-called hip abductors which do not abduct the hip at all in walking, but do fix the pelvis. It is

this group of pelvis fixators which have accounted for most of our failures. With a lengthened leg more strain is thrown on this group than with a short leg and the limp due to them correspondingly increases. Cases in which the major element of the limp is from weakness of the hip abductors, or as we prefer to call them, the pelvis fixators, will not be benefited by lengthening the leg. Cases in which the main element of the limp is due to the mechanical disadvantages of a short leg will be much improved. Paralysis of the quadriceps does not seem to be quite so vital an element affecting the gait after a leg lengthening except for the possibility we have already mentioned that its relative power may be changed by the lengthening of the leg. Of course quadriceps weakness and hip abductor weakness are usually associated, but in these cases the quadriceps does not seem to be the vital factor in the resulting limp. One patient in whom the quadriceps was strong while the gluteus medius was weak is walking better though it was with some misgivings that the operation was done.

In order to make a fair appraisal of the value of leg lengthening it seems necessary to consider briefly some of the difficulties of the operation itself. In this we include observations made on all forty-one of the cases, not confining ourselves to the twenty considered as end results.

The difficulties we feared before we began the operation were infection, failure of union, displacement of the bone and displacement of the foot. As to infection we had three, one of the bone and two skin-stitch abscesses. While this is a much higher percentage than we have had in other operations, we do not believe it is quite fair to blame it entirely on the operation. The one severe infection was apparently due to outside circumstances and operating on that particular day was an error in judgment. Nonunion has not occurred as yet. This we are more inclined to attribute to luck than to any special precautions. Incidentally we do not use a

motor saw, but split the bone with a thin blade osteotome, but whether this has anything to do with it is doubtful.

Displacement of the fragments has not been troublesome, though it has occurred to a moderate extent in a few cases. We have noted that in practically every case there is a slight displacement as the longitudinal cut of the bone is completed. The bone springs slightly from its former shape. This is apparently due to the fact that the tibia has a definite grain, as a piece of wood might. This grain is somewhat spiral and seems to be associated with some internal strain of the bone, which causes the springing action noted. Displacement of the foot has been much more troublesome. In two cases it was marked and necessitated secondary operations. It occurs to a lesser degree in practically all cases. The amount and direction of the displacement is determined by the balance of the power in the muscles. We now make it a rule to leave any foot stabilization operation that may be needed until after the lengthening has been obtained. The stabilization procedure can then be modified to meet the individual deformity.

In connection with the foot and ankle we have encountered another unanticipated difficulty. Most of the patients experience some loss of ankle motion. In a number there has been almost complete loss of motion but no ankylosis as shown by x-ray. Since most of the patients operated on have had almost flail ankles, a certain amount of blocking of ankle motion does no harm, but complete loss is likely to lead to marked eversion of the foot with an awkward gait. This loss of ankle motion we account for as follows: In our cases we have noted a rapid decalcification of the tarsal bones. It is often of such high degree that one sees only an eggshell appearance in the x-ray plate. It appears within two weeks after the operation, when deposition of calcium begins in the gap between the bone fragments. It is an open question whether this decalcification is simply an atrophy of disuse or whether the cancellous bones of the foot

are used as a calcium reservoir from which the defect in the shaft of the tibia is replenished. There is also a lesser degree of decalcification in the lower cancellous end of the tibia. One is tempted to assume that the calcium is withdrawn for repair. A physiologist at Northwestern University is attempting to determine the real explanation, but whatever the explanation, the decalcification is a very real difficulty. If one attempts to maintain the position of the foot by pressure, the tarsal bones, particularly the astragalus, are crushed. On the other hand, if the foot is allowed to distort and is later corrected by a sub-astragaloid arthrodesis, the tarsal bones are easily crushed during this operation. The change usually produced is a flattening of the dome of the astragalus under the tibia, which limits the ankle motion in dorsi- and plantarflexion. If this limitation is not too marked it makes an excellent block for a flail ankle, but it is difficult to control the amount of the limitation. The decalcification disappears with use and, as usual, the arthrodesis produced in these decalcified bones is good.

Nerve disturbance shown by loss of sensation from the lengthening has occurred in two cases. In both it cleared up in about six to eight weeks and in neither was any trophic sore produced. In both these cases lengthening was well over 2 inches.

SUMMARY AND CONCLUSIONS

1. Equalization of leg length by lengthening of the bones of the lower leg is feasible and the equality will be maintained through the period of growth at adolescence in the great majority of cases, at least in poliomyelitis cases. We do not believe the operation is worthwhile in a patient who has not sufficient power to walk without a brace.

2. Equalization of leg length does not improve the gait in poliomyelitis cases unless certain conditions as to muscle power are met. First, the gluteus muscles must have adequate power to fix the pelvis

against gravity when walking. Second, the quadriceps must have enough power to extend the knee against gravity plus several pounds resistance applied to the ankle. Third, if there is any doubt as to whether the gait will be improved by leg lengthening the shoe should be built up an amount equal to the proposed lengthening and the gait observed for a week or two.

3. In view of the difficulties of the operation and after-care we do not believe the operation is worthwhile for less than 1½ inches of shortening.

4. More than 3 inches of lengthening is risky on account of the danger of nerve disturbance.

5. Shortening due to old osteomyelitis we consider an absolute contraindication to leg lengthening because there is danger of lighting up the infection and the bone is of poor quality. Shortening following osteo-myelitis is prima facie evidence of poor bone.

6. Congenital shortening is a relative contraindication and each case must be decided upon individually.

7. Shortening due to epiphyseal injury has not maintained the lengthening which may be obtained.

In this study we have tried to be as objective as possible and not to be influenced by parents, patients, interns or nurses. We have noted in our earlier patients that the ones showing the better results were chosen, unknowingly, to fulfill the criteria given above. As these observations formulated themselves and we began to choose knowingly, the results have been more satisfactory, but the series has not grown rapidly. We believe the operation has a field of usefulness within the framework we have outlined.
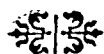
REGIONAL ILEITIS

RÉSUMÉ OF PRESENT KNOWLEDGE AND THE ADDITION OF TWENTY-TWO CASES FROM BROOME COUNTY, NEW YORK

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CICATRICIAL or regional enteritis is a nonspecific low grade inflammatory process in a localized area of the intestinal tract. It generally affects the terminal ileum but may be found in any part of the intestinal tract.

Reports of cases under various names have been known in literature as early as 1806,[1] but a clear cut description of this clinical entity was not given until 1932.[2] At this time Crohn and his associates gave a comprehensive pathological and clinical description of this disease and differentiated it from other similar conditions. Since then, cases have been reported from all over the world and in all classes and kinds of people. The original concept of a disease limited to the ileum was expanded to include the entire intestinal tract. Regional colitis has been differentiated from this condition by some men[3] but generally the condition is considered the same.

The etiology is obscure. Felsen[4] believes bacillary dysentery the cause. Bargen[6] and writers in general disagree. Stafford[5] suggests that a virus may be the cause. Crohn[7] and Bargen[8] admit the possibility. Bargen[8] and others of the Mayo Clinic[9] despite all negative tests are of the opinion that the condition may be of tuberculous origin. The definition generally accepted is that this is a nonspecific granulomatous condition accompanied by lymphstasis or blocking.

The pathology is that found in nonspecific granulomas and is characterized by an inflammatory reaction in which there is a marked productive element. Ginzburg and Oppenheinmer[10] in a study of nonspecific granulomas of the intestine including ileitis state that histologically a study of all the various types of lesions show "merely evidences of various degrees and stages of acute and chronic inflammation with infiltration by lymphocytes, polymorphonuclear leucocytes, plasma cells and mast cells, together with varying degrees of fibroblastic proliferation and often degenerative changes. In some of the peri-intestinal lesions there is often considerable hyalinization and calcification and even early bone formation has been encountered. The presence of giant cells is a common finding." They believe that these are of only accidental significance and are due to the presence of particles of nonabsorbable vegetable matter which have become incorporated within the lesions as a result of deep ulceration and which act as irritants. Hadfield[11] is the only pathologist found by the writers who claims to be able to identify the specific histological picture of regional ileitis.

The gross appearance depends on the stage when first noted. During the acute process the bowel is edematous, thickened and injected with a rough, easily bleeding, granular serosa, often covered with tubercle-like formations. The mesentery is thickened and contains enlarged but discrete nodes. When sufficiently advanced, the gut feels like a "rubber hose." Areas of normal bowel between sharply defined diseased segments—so-called "skip" areas— may be present. These normal areas may vary from a few inches to several feet. Failure to note these is regarded as a reason for recurrence after adequate complete removal of the diseased segment.[12]

The disease process in the terminal ileum seems to extend into the cecum, but in most cases it ends at the ileocecal junction. However, the cecum may be affected, either by extension of the process or alone. As noted above, the same process may be seen in the jejunum or in the colon or in small bowel and colon at the same time.

Clinically, early cases often have symptoms suggestive of acute appendicitis and the true condition is discovered only at operation for this condition. There is lower abdominal pain, elevated temperature and an increased white blood count. The pain, however, is often diffuse and may even be on the left side. Crohn[7] believes that diarrhea is a constant finding and differentiates this condition from appendicitis.

As the disease progresses, due to interference with the blood and lymphatic supply, ulceration of the mucosa occurs. The breaking down and attempted healing in the bowel cause symptoms of a mild colitis. The healing process may cause scarring with mild obstruction. The diarrhea is less marked than in ulcerative colitis. Recurring bouts of abdominal pain, fever and diarrhea are common. Due to the fibrosis a mass may be felt, usually in the right lower quadrant. The distortion and rigidity of the bowel due to the scarring causes a constant defect in the x-ray film which has been labeled the "string" sign by Kantor. This is considered to be pathognomonic of ileitis when present.

The next stage is that of advanced scarring with signs and symptoms of intestinal obstruction. The bowel is leathery and the wall thick and fixed. The mesentery is thick and rigid. Severe cramps, nausea and vomiting are noted clinically. An abdominal mass is usually present. X-ray examination shows a dilated small bowel above an area of obstruction.

The last stage is characterized by the development of multiple sinuses and fistulas between the various loops of bowel and between the bowel and the outside.

Fecal fistula following appendectomy is one of the pathognomonic signs of a residual ileitis. Crohn[4] reports fistulous tracts to the inguinal region, lateral abdominal wall, right lumbar and perianal regions. Rectal and rectovaginal fistulas are sometimes seen. Due to the slow perforation, abscesses may be found walled off by the surrounding bowel. The omentum is thickened and granular and seems plastered to the adjacent viscera. The process may be so widespread that exact delineation of the pathological process may not be possible. The bowel is markedly thickened and of a leathery texture.

In the advanced cases aside from those with abscess formation a short circuiting procedure with section of the ileum will cause the acute process to subside. At the second operation the pathological appearance will be entirely different. The disease process will then be seen to involve a comparatively short segment, usually the terminal ileum. The rest of the intestinal tract will seem normal. Even the omentum will have regained a fairly normal appearance and can be freed with comparative ease from the adhering bowel. The involved segment will have a leathery appearance and will have lost its acutely inflamed look. It is usually quite rigid and fixed to the underlying thickened mesentery. In the lumen due to the alternate breaking down and healing process the intervening uninvolved mucosa is thrown into prominence giving the mucosa a cobble-stone appearance which is characteristic.

The writers would like to emphasize with Crohn that the pathological process does not necessarily conform to the clinical picture. The process may be slow with immediate healing causing obstruction with little or no acute inflammatory changes noted grossly. On the other hand an acute onset may usher in the last stage of an ulcerative or obstructive lesion with abscess formation. Thus while the acute type may usually be considered not

to show the advanced lesions, occasionally at operation for an acute abdomen a definite peritonitis with an advanced stage of ileitis with perforation into the general abdominal cavity may be found. Marshall[13] and Querna[14] each report a case of general peritonitis following perforation with fatal outcomes.

DIAGNOSIS

The diagnosis of ileitis should always be considered in a young patient with recurring attacks of abdominal pain, diarrhea and loss of weight. Also in cases of chronic partial intestinal obstruction accompanied by signs of a low grade inflammatory process. The presence of diarrhea according to Crohn[7] definitely rules out acute appendicitis. From personal experience we differ with him on that point. However, recurring attacks of abdominal pain and diarrhea accompanied by loss of weight, slight fever, leukocytosis and anemia in a young individual should lead one to look for ileitis in the absence of a definite ulcerative colitis. The presence of a mass in the right lower quadrant is highly suggestive when present. Fecal fistula following an appendectomy is another highly suggestive finding. It is in these cases that the x-ray examination will demonstrate the rigid terminal ileum usually in the form of the "string-sign" of Kantor. According to Brown, Bargen and Weber[15] the x-ray is the chief diagnostic aid.

The differential diagnosis is easy according to Crohn.[7] He believes that with the exception of primary ileocecal tuberculosis, which is practically nonexistent, a careful history and x-ray and sigmoidoscopic examination will demonstrate the disease when present. Other writers, including ourselves, are not so optimistic. Brown, Bargen and Weber reported eighteen cases from the Mayo Clinic in 1934 with the following preoperative diagnoses: Inflammatory lesion of the bowel, eight; undetermined type of obstruction of bowel, eight; carcinoma, one; cholecystitis, one. Cutler[16] mentions a case which was classified as regional enteritis for two years before the true diagnosis of carcinoma was made. Two cases which were carefully studied in our hospital, one of which had a typical "string-sign," turned out to have appendiceal pathology only. In our experience and that of most of the writers on the subject, the condition was often first noted at operation.

TREATMENT

The treatment of regional ileitis is considered surgical at the present time. Dr. Elliott Cutler, Professor of Surgery at Harvard University, disagrees. He states that in his experience and that of his colleagues, surgery has been of little value, except when signs of obstruction or abscess presented. He questions the reliability of the cures reported by the advocates of surgery and believes he can get the same or better results by medical treatment.[16] Crohn[12] answers this by stating that when the disease has progressed to definite scarring, the bowel is permanently damaged even though clinically the patient is well. If this is not remedied, there will be future trouble. He reports one case demonstrating this point. Marshall[13] agrees with this concept.

Both Crohn and Cutler agree that medical treatment should be used in acute cases, and in those which are too far advanced for radical surgery.

The medical treatment suggested by Cutler and which is generally used, consists of a bland diet containing a high protein, high vitamin and low residue content. Mineral oil is suggested. The use of supportive measures such as blood transfusions, alpine light, bed rest, etc., are used as indicated. Crohn experimented with the use of typhoid and other nonspecific therapy without success.[12] X-ray therapy is also advocated by Cutler in some cases. The writer has used it in one case without much success.

The surgical treatment is still being debated. Acute conditions found at operation should be left alone unless obstruction

exists. In this case an ileocolostomy or even enterostomy as reported by Kross[17] may be indicated. In the presence of perforation or signs of peritonitis or abscess formation simple drainage is advocated. The use of more complicated procedures results in a high mortality.[13,14]

The treatment of the appendix in cases of acute ileitis is debatable. Fecal fistulas following appendectomy are reported in nearly all series. On the other hand, simple appendectomies with cure are also reported in the same series. The exact percentage of fecal fistula compared to the total number of cases with appendectomy only is not known, but from the series we surveyed, the percentage is fairly high.

Ileocolostomy with section of the terminal ileum was originally advocated as the first step of a radical resection. The same procedure without transection of the ileum has been found to be unsatisfactory due to the fact that the diseased segment is not put at rest. As a result progression occurs making the next step difficult if not impossible. Pemberton and Brown[18] report six of eight patients with ileocolostomy only as well two to five years later. Colp and Ginzburg[12] report twenty-two cases with this procedure only with twenty clinical cures. The remaining two cases had fecal fistulas and they emphasize that in this type resection must be done later. Ileo-transverse colostomy by the side-to-side technic is generally employed. The position of the ileum as regards iso- or antiperistalsis is unimportant. Ileosigmoidostomy may be used if a normal bowel cannot be found proximally.

Radical resection is at present the most widely used. This may be done in one or two stages. The first stage may be an ileocolostomy or as advised by Marshall of the Lahey Clinic, resection by the Mikulicz procedure as modified by Lahey. In this the mass is removed at the first stage leaving a double-barreled colostomy opening with the ileum longer than the colon spur. A tube is immediately inserted into the ileum. Later the spur is crushed and the patient sent home. Repair of the colostomy is done several weeks later. Primary resection with immediate anastomosis is employed frequently. The series from the larger centers show a preponderance of this procedure.

RESULTS

Radical surgery is attended with a mortality of about 15 per cent.[12] Recent reports from the larger clinics have bettered this. Marshall reports resection of the affected loop in twenty-two patients without a fatality. Seventeen of these patients were operated upon by the modified Mikulicz procedure. In four additional cases ileocolostomy alone was done with one fatality and in three others drainage of abscesses was accompanied by one fatality. This gives a total of twenty-nine cases with two deaths. Clark and Dixon[9] report forty-four cases of which fourteen had an ileocolostomy with four deaths; fourteen patients had a one-stage resection with one death, fifteen had a two-stage resection with two deaths and one had a simple exploration and recovered. Blackburn[20] and his associates report sixteen one-stage and four two-stage resections without mortality. Two other cases had short circuiting procedures with equally good results.

Crohn has advocated radical resection believing that about 50 per cent of the palliative procedures are followed by recurrence. Recently he has swung to the conservative side and feels that ileotransverse colostomy should be performed, as advocated by Colp and Ginzburg.[19] He attributes the high mortality reported to the fact that cases are seen after extensive involvement has occurred or after delay in resorting to surgery.

The recurrence rate quoted by Crohn is 7.7 per cent. This is ascribed to too conservative resections. He contends that the amount of bowel remaining is immaterial as far as ability to live normally. Marshall reports two recurrences in his twenty-nine cases. Blackburn[20] in twenty-two cases reports no recurrences.

Crohn[12] states that there is a 90 per cent return to health when the proper surgery is used. This seems borne out by the results quoted above. The discrepancy between this and the statement of Dr. Cutler of practically no cure lies in the method of interpreting the patient's clinical status. Crohn[7] relies on the fact that the patient has gained weight and is able to carry on his occupation. Cutler[16] makes use of the x-ray interpretation by the "motility" series and classifies only as cured that rare case which has absolutely no intestinal symptoms and a completely normal gastro-intestinal tract as evidenced by careful examination.

REGIONAL ILEITIS IN BROOME COUNTY, NEW YORK

This study comprises twenty-two cases of regional ileitis which have been found in the records of the Binghamton City Hospital (565 beds) (seventeen cases), The Wilson Memorial Hospital, Johnson City, New York (328 beds) (three cases), The Ideal Hospital, Endicott, New York (116 beds) (no cases), and from Our Lady of Lourdes Hospital (seventy-nine beds) (two cases). They total a hospital capacity of 1,088 beds and are located in the City of Binghamton, Towns of Johnson City and Endicott, New York. These hospitals supply a population of about 155,000 composed of both urban and rural districts.

The classification used by Cutler[16] and Mixter,[21] which considers the condition the same no matter in what part of the intestinal tract it occurred, was used.

Many of the cases were questionable from the pathological viewpoint and have been included only after careful analysis. In many cases the opinion of Dr. Burrill Crohn gave the correct diagnosis. The pathological picture was often not characteristic and only found at later resections. In other words, Homans and Hass'[22] statement of ileitis being a clinical and not a pathological entity seems justified according to this series.

The twenty-two cases were admitted in the following years: one in 1930; one in 1933; one in 1935; six in 1936; five in 1937; two in 1938; five in 1939 and one in 1940.

The age grouping falls within the range quoted in literature. There were nine males and five females in the resected groups. There were four males and four females in the group in which simple appendectomy or exploration only was performed. The total in the group was thirteen males and nine females.

When originally described in the early reports it was stated that regional ileitis had a predilection for the Hebrew race. Recent literature, however, has demonstrated that this is a fallacy and that the disease may occur in any race and in any class of people. There were no Jewish patients in our entire series.

Fourteen of the twenty-two cases had resections of the bowel. The other eight had either simple appendectomy or drainage.

The nonresected cases were diagnosed in the last four year period (1936 to 1940 inclusive). This suggests that the condition has been looked for with any thoroughness only during that period. It also indicates that similar cases probably were present in other years and not noted. Since the occurrence of persistent fecal fistula during this and previous years was not found, the writers draw the conclusion that acute cases of regional ileitis had best be left alone as they will subside spontaneously. Ginzburg[23] has emphasized this point in a recent paper.

The eight nonresected cases had no treatment directed to the ileitis (Cases xv to xxii inclusive). These were all acute and found unexpectedly at operation. Only one (Case xxi) had diarrhea which is contrary to the history to be expected in ileitis according to Crohn.[7] Six had simple appendectomy without drainage. One (Case xxi) had freeing of adhesions about the cecum due to a previous appendectomy and one (Case xv) had drainage of the peritoneum without appendectomy. The last two showed signs of acute peritonitis.

Cultures of the peritoneum were not done. All of these have recovered and are clinically cured. Since the longest period elapsed is four years, there is a possibility that there may be active involvement at a future date. Case XVIII which showed extreme thickening of the terminal eighteen inches of the ileum in a four year old child would seem to be the best candidate for recurrence since only two years have elapsed since operation. A gastrointestinal series was negative during the hospital period but since we do not use the "motility" series declared necessary by Cutler[16] it is probable that the condition was still present on discharge. It is inconceivable that the amount of pathology found at operation would completely disappear in a few days.

The removal of the appendix in the six acute cases did not result in formation of fistulas which is again contrary to what is generally believed. It seems to the writers that removal of a probable future offender, the appendix, is better for the patient than failure to do so in order to prevent a possible fistula. Our cases and others[24] reported in literature would tend to substantiate this.

There were fourteen cases which underwent radical resection in one or more stages. Four of these had appendectomy without fistula formation before the condition was recognized. One of these (Case IV) had an appendectomy three years before. The involvement of the ileum was noted at the time and considered to be tuberculous. This was an advanced case according to the writer's concept of the condition at this time. The case was not acute and we believe with Crohn that surgery directed to the ileum was indicated at that time. Cases II, X and XI also had appendectomies, two, one and three years, respectively, before resection. Apparently nothing abnormal was noted in the ileum at the time in any of these. The condition found at the secondary procedures was far advanced with marked obstruction necessitating radical surgery in each case. Case II had an ileo-

colostomy without section of the ileum followed by removal of the terminal ileum, cecum and ascending colon. A supravaginal hysterectomy and salpingectomy were done at the same time. Clinical cure resulted. Case IV had an ileocecostomy, ileosigmoidostomy, resection of ileum, cecum and ascending colon with permanent colostomy, freeing of pelvic colon, permanent ileostomy and ileotransverse colostomy with later development of a fecal fistula in sequence. The result is a bedridden patient. The outlook seems hopeless for clinical recovery. Case X had a resection of the affected ileum with recurrence necessitating further resection. He is clinically improved but not cured. Case XI had a resection of the terminal ileum and cecum and died of a cerebral accident six days postoperatively. At operation a fistula between the ileum and the ascending colon was found. The diagnosis at the time of operation was carcinoma.

In summary, one patient died (Case XI), one is an invalid (Case IV) and one (Case X) after two radical resections must still be considered to have the condition still active. Only one patient (Case II) may be considered to be clinically cured. These cases strongly indicate the necessity for differentiating the "acute" cases which will spontaneously regress from those which have reached the scarring irreversible stage and in which immediate surgery is indicated to prevent the sad results listed above. We are of the opinion that a primary ileocolostomy with exclusion might have improved the results. Radical resection was apparently either inadequate or performed too late.

Two cases (Cases VII and IX) had appendectomy with fistula formation. Repeated attempts were made to close these without success. The explanation given by Ginzburg[23] that the fistula is due to an ulcerative process in the bowel wall which will not close as will the cases due to back pressure following appendicitis is well borne out. Case VII had jejunal involvement at the second radical operation necessitating re-

section of jejunum as well as ileum and colon. He also had an ischiorectal fistula which may well have been a peri-anal sinus from the affected bowel. Case IX had thirteen operations before clinical cure was obtained. Most of these were attempts at closure of the fistula. Finally the terminal ileum, cecum, ascending colon and part of the transverse colon were removed. His last hospital stay was for a period of three years. Healing was not obtained until after the radical resection. This corroborates the findings of Colp and Ginzburg[19] of the necessity for radical resection in cases of abdominal fistula. One of the above patients has apparently been completely cured (Case IX). The other patient (Case VII) is clinically well but may be classified as "disease present and still active." He has occasional abdominal upsets and has to watch his diet carefully.

One patient (Case VI) was operated upon during the abscess stage and was treated by enterostomy and drainage with subsequent drainage of further abscesses as they developed. Later radical resection of the ileum, cecum and ascending colon resulted in a clinical cure.

Another (Case VIII) had involvement of the sigmoid only and was treated by exteriorization and resection with subsequent closure of the colostomy. At the time of the operation the condition was considered to be malignant. The patient is clinically well.

Four cases (I, V, X and XIV) were treated by radical resections of the ileum only with immediate anastomosis as the primary procedure. Case X only had had a previous appendectomy. As mentioned before, recurrence occurred necessitating further removal of ileum but without touching the cecum. Case I had a primary resection of the ileum with a clinical cure. He has occasional abdominal distress but the gastrointestinal series have been negative. Case V had a primary resection of the ileum during the acute stage with generalized peritonitis, resulting in an operating room fatality. In the light of literature and Cases XV and XXI in our series simple drainage might have changed the outcome. Case XIV had resec-

tion of the terminal ileum and ileocolostomy with clinical cure.

The three surviving cases substantiate Mixter's[21] statement that removal of the cecum is not necessary unless it is affected, as long as a fairly large area of normal small bowel is left at each end of the diseased area. The recurrence (Case X) was due to failure to remove mesenteric glands attached to underlying large blood vessels.

Crohn believes that resections should always include the cecum if the ileum near it is involved. The above questions this statement.

Three cases (III, XII and XIII) had radical resections of terminal ileum, cecum and part of the ascending colon without previous operative procedures. In two (XII and XIII) the condition was not suspected, the diagnosis being appendiceal abscess and ectopic pregnancy, respectively. The other (Case III) had a typical history of ileitis with diarrhea, loss of weight, etc., and was not admitted as an emergency. She died following a second operation for intestinal obstruction which developed postoperatively. The complication of intestinal obstruction following intestinal resection is one of the reasons given by Colp and Ginzburg[19] in advocating ileocolostomy. Cases XII and XIII are clinically cured. Proximal enterostomy was done in Cases III and XIII.

In summary, two cases (II and IV) had preliminary short circuiting operations followed by radical resections. One (Case VI) had drainage of abscesses and ileostomy with later resection. One case (VIII) had a Mikulicz procedure. Ten cases (I, III, V, VII, IX, X, XI, XII, XIII and XIV) had radical resections in one stage.

Mortality. There were no deaths in those having a two-stage or Mikulicz operation. There were three deaths in the ten primary rections giving a mortality of 27 per cent. The total mortality for the resected cases (14) was 21 plus per cent. The mortality for the entire series of twenty-two cases was 13.6 per cent.

A survey of the above shows definitely that while primary resections if radical

enough will give the best results, the mortality is prohibitive in the average surgeon's hands. That this applies generally may be noted by comparing this report with that of T. H. Russell from the Post-Graduate Hospital in New York City listing twenty-seven cases of which eleven had appendectomy only with three deaths.[25]

clinically well for about four years before a second operation was necessitated by obstruction. Following this procedure he has remained well to date—six years.

Three other cases (IV, VII, IX) had multiple operations but none of these was ever well between the various procedures. Case IV was undoubtedly inoperable when radi-

REGIONAL ILEITIS
BROOME COUNTY, NEW YORK

Case*	Age	Year	Procedure	Abdominal Fistula	Recurrence	Clinical Result
I	49	1937	Primary resection	0	No	Cured
II	44	1936	Stage resection	0	No	Cured
III	19	1936	Primary resection	0	.....	Died
IV	22	1937	Stage resection, multiple operations	0	Yes ?	Surgical failure
V	17	1936	Primary resection	0	.....	Died
VI	33	1936	2 stage resection	0	No	Cured
VII	26	1933	Primary resection	Yes	Yes ?	Improved
VIII	47	1936	Mikulicz' procedure	0	No	Cured
IX	34	1935	Primary resection	Yes	Yes ?	Cured
X	22	1930	Primary resection	0	Yes	Improved
XI	57	1939	Primary resection	0	.....	Died
XII	21	1939	Primary resection	0	No	Cured
XIII	27	1938	Primary resection	0	No	Cured
XIV	12	1939	Primary resection	0	No	Cured
XV	38	1937	Drainage	0	No	Cured
XVI	14	1936	Appendectomy	0	No	Cured
XVII	17	1935	Appendectomy	0	No	Cured
XVIII	4	1938	Appendectomy	0	No	Cured
XIX	55	1937	Appendectomy	0	No	Cured
XX	19	1939	Appendectomy	0	No	Cured
XXI	60	1939	Freeing of adhesions	0	No	Cured
XXII	15	1940	Appendectomy	0	No	Cured

Total: Appendectomies.. 6
   Drainage.. 1
   Freeing of adhesions... 1
   Resections.. 14
   Recurrences... 4
Results: Clinically cured... 16
   Improved.. 2
   Surgical failure... 1
   Deaths.. 3

* These patients were operated upon by Doctors Bowen, Cunningham, Dyer, Henry, Hobbs, W. T. King, H. J. King, Matthews, Molyneaux, Moore, Pope, Squires, Sneierson, Torrance and Whittemore (deceased).

There were four recurrences in the fourteen resections. If one classifies as recurrence those cases which after operation are clinically cured for a varying period, only one in our series was a true recurrence (Case x). In this case the mesenteric glands were so enlarged and adherent to the underlying large vessels that they were not removed at the first operation. He was

cal resection was attempted. Cases VII and IX had fecal fistulas after appendectomy and these were present during the entire operative course until complete healing and clinical cure resulted. These should be classified as extensions due to inadequate primary surgery and not as true recurrences since the focus was not removed originally. These cases indicate that resec-

tion must be radical and thorough to be of lasting value. One case (VII) required jejunal resection at one of the later procedures and it is possible that this "proximal minimal" lesion was present at the original operation as suggested by Colp and Ginzburg[19] and was not a recurrence.

SUMMARY

1. A brief résumé of the literature on regional ileitis including the pathological and clinical picture of this entity has been presented.

2. The conflicting opinions of various authorities as to etiology, pathology and treatment have been presented.

3. Twenty-two cases from Broome County, New York, have been reported and discussed.

4. The conclusions of the writers are that: (a) Regional ileitis or cicatrizing enteritis is a clinical rather than a pathological entity and is the same no matter what part of the intestinal tract is affected. (b) Acute cases found inadvertently at operation had best be left alone or if obstruction is present a short circuiting operation with section of the ileum performed. Routine appendectomy is safe unless radical resection is planned at a later date. (c) Radical resections especially in one stage carry a prohibitive mortality in the hands of the average surgeon. When indicated a two-stage procedure is safer, either by previous ileocolic anastomosis with section of the ileum or by the Mikulicz procedure as advocated by the Lahey Clinic. (d) Ileocolostomy with exclusion seems to be the best procedure to date except in cases with abdominal fistulas. In these cases radical resection in two stages seem safer.

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THE MANAGEMENT OF SCOLIOSIS*

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THIS article is prompted by the frequently heard statement, "You can't do anything for scoliosis anyway." It is a plea for the recognition of the fact that scoliosis can be effectively treated, and should be treated for the physical and mental well being of the patient.

ETIOLOGY

It is obvious that a causative factor should be determined. Its importance cannot be overemphasized, as it determines both the prognosis and the treatment. In this report we are not considering the functional curve from short leg length and faulty posture, or the temporary curve caused by muscle spasm.

Paralytic. At the Oklahoma Crippled Children's Hospital, poliomyelitis is the commonest cause of scoliosis. These curves may be caused by either back, abdominal, hip or shoulder girdle paralysis. They are usually progressive and may get worse through adult life. The resulting deformity is often extreme and may be incompatible with life. Without exception every case with asymmetrical trunk paralysis will develop a scoliosis. On the other hand, those with symmetrical paralysis usually do not develop a scoliosis. Extensive paralysis may result in double primary curves, greatly complicating the picture. High dorsal curves cause marked chest deformities with decided reduction in vital capacity. This one factor alone may make an invalid of the patient and predispose to fatal pneumonia, etc. The severe rib deformity causes a grotesque appearance which is embarrassing to the patient who is often unwilling to appear in public. On the other hand, the lumbar type of curve, usually resulting from abdominal muscle paralysis, seldom causes much respiratory embarrassment. Many of these patients will, however, suffer from tilting of the pelvis with resultant apparent disproportion in leg length and loss of balance. They may not be able to stand or sit erect.

Idiopathic. Most of this group are husky, well developed girls between the ages of ten and fifteen. Ninety per cent of these curves are midright dorsal. No muscle imbalance is found. The curves usually start insidiously without a history of significant illness or familial tendency. We have only two instances in which two members of the same family had idiopathic scoliosis. The old theory that these curves were due to carrying heavy school books has been generally discarded. However, the similarity in habitus and the frequently associated menstrual disorders probably indicate the presence of an endocrine factor. The curve does not progress after the cessation of growth.

Thoracogenic. 1. *Empyema:* This curve is caused by the glueing together of two or more ribs by scar tissue, with continued growth of the opposite side, forming a curve with the concavity toward the lesion. Therefore, these curves also do not progress after cessation of growth. The severity of the deformity depends upon the age of onset. All children with chronic empyema should be closely watched for scoliosis.

2. *Tuberculosis.* Many patients with unilateral fibrous tuberculosis of the lung develop mild curves which seldom progress. However, following thorocoplasty practically all patients develop a scoliosis with the convexity toward the lesion. In adults these curves are usually mild and self-limited. In children they are nearly always severe and progressive.

Congenital. These curves are usually noticed in early infancy. They are short and sharp with long and usually inadequate compensatory curves. There frequently is a demonstrable hemivertebrae or other congenital anomalies of the spine or ribs and the curves seldom progress. The appearance of the patient often becomes worse with growth, however, because the deformity is magnified.

Neuropathic scoliosis usually develop very rapidly with long severe curves. Scoliosis may develop with syringomyelia, cord tumors, von Recklinghausen's disease, cerebrospastic quadriplegia, hydrocephalus, spina bifida, etc.

There are many other causes of scoliosis such as vertebral epiphysitis, myositis ossificans, rickets, fractures, etc., but they are relatively rare and require treatment of the primary condition.

It should be remembered that two or more conditions may occur simultaneously. For example, we have under observation a patient with poliomyelitis with a congenital scoliosis, and another that was treated for idiopathic scoliosis before the onset of her poliomyelitis. It is obvious that a careful history and physical examination are essential, but in spite of careful examination and repeated roentgenograms we have been unable to classify five cases.

TREATMENT

The treatment of scoliosis depends on progression of the curve, imbalance, deformity and pain. The latter, surprisingly enough, is rather rare. Occasionally, the patient with a high dorsal curve will have pain due to impingement of the scapula on the angulated ribs. In one of our cases the scapula would sometimes be caught against the ribs so that the patient was temporarily unable to raise his arm. In this case rib resection was indicated.

1. The postpolio scoliosis presents the most difficult problem. High dorsal curves receive no support whatever from the usual type of brace, plaster or celluloid jacket. Despite improvement in appearance, roentgenograms taken with the brace on will show that the curve is not being supported. *If the curve was progressing before the application of the brace, it will continue to do so after the brace has been applied.* Therefore, one should first determine whether the curve is progressing. This can best be done by making standing films at two to three month intervals. If the spine is mobile, the curve will probably progress. If it is stiff, it will probably not progress although this is not always so. The lumbar curve lends itself much better to some sort of support. Celluloid jackets, plaster corsets, or a Barr type of adjustable brace, may prevent progression of the curve. However, the support will probably have to be worn for many years until Nature herself stiffens the curve. When lateral abdominal paralysis is present, the instability of the patient may be greatly improved by a Lowman transplant and deformity may be prevented. But this procedure will not stop progression of an already formed curve. As in the transplant of tendons in the paralytic foot, it serves to balance but will not stabilize. Most of these patients will ultimately need fusion if a severe deformity is to be prevented. It has been said that the stiffening of a spine by fusion is unphysiological but any primary curve in a patient over thirty becomes stiff anyway. The best time to treat the polio back is before the curve starts. No patient with back or abdominal muscle weakness should be allowed to sit up without adequate support. Usually long support in plaster in recumbency is necessary.

2. The idiopathic curve presents an entirely different problem. If the patient is young and the curve progressing rapidly, correction and fusion is the method of choice. But, if the patient is fifteen or sixteen and a comparison of her height with that of other members of the family suggests that she has about attained her growth, simple support is all that is necessary. It will probably not have to be continued for more than a year or two and
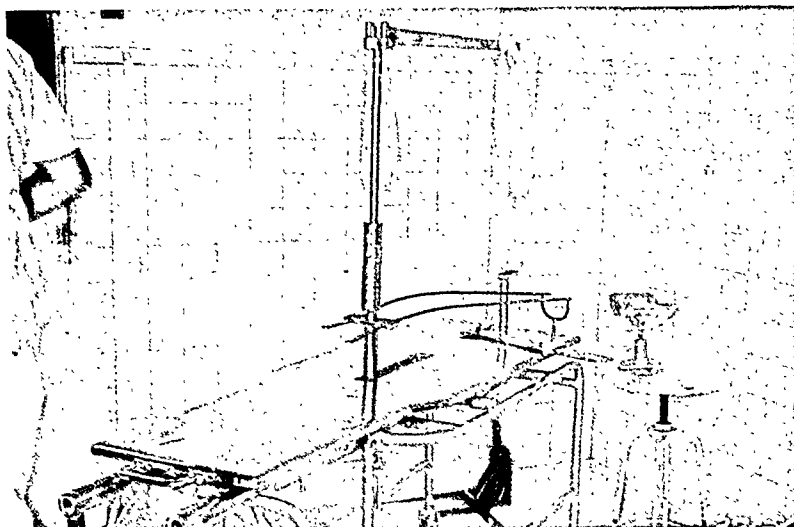
FIG. 1.

FIG. 2.
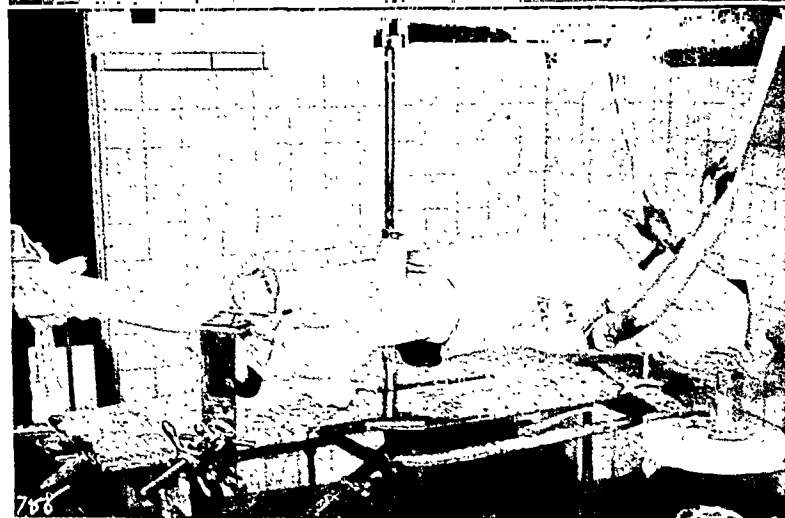
FIG. 3.

FIG. 1. Attachment used on Hawley table with irons bent to fit patient.

FIG. 2. Patient with padding applied.

FIG. 3. Same. Plaster extends to right knee on convex side of primary curve.

no further deformity will result. But, this method is merely supportive not corrective. The important thing about this type

FIG. 4, Case J. D. Age 13. Idiopathic scoliosis. Preoperative photograph.

of curve is that a majority of these cases stop progressing *before cessation of growth*. It should, therefore, be emphasized that supportive treatment should not be used until there is roentgenographic evidence of progression of the curve. Otherwise, the patient is loaded down with much useless paraphernalia which may well be detrimental to health as well as being a nuisance. Back and abdominal muscle exercises and physiotherapy will keep these patients occupied until progression can be determined. Because the curve is usually mid-dorsal, braces are of no use unless they extend up under the chin and occiput. This makes a very heavy, cumbersome appliance. Celluloid jackets, or light plaster jackets, extended over the shoulders, provide the best means of support. When a celluloid jacket is applied, the use of the Murk-Jansen plaster bed at night may help to maintain correction. Models for

the celluloid jackets are made with the patient in suspension and therefore some correction is obtained. Similarly, a Murk-

FIG. 5. Case J. D. Twenty six months postoperative.

Jansen bed is convex and the patient lies on it on the convex side of her curve thus allowing her weight to aid in the correction.

3. Scoliosis occurring because of chronic empyema in young children should be treated by fusion, as the curve will progress even in a plaster support. If the patient is close to the end of the normal growth period (usually sixteen years for girls and seventeen years for boys), no treatment is necessary for prevention of deformity. Cosmetic improvement is best obtained by resection of the affected ribs, followed in two to three weeks by the application of a plaster jacket with correction and fusion in the usual manner.

Scoliosis in tuberculous adults, with or without thorocoplasty, usually does not require treatment. In children following thorocoplasty spine fusion is nearly always necessary because of rapidly increasing scoliosis. Fusion should not await the

development of a severe deformity. Correction in the usual manner should be instituted early. However, it is usually best to do these operations under local anesthesia.

FIG. 6. Case J. D. Preoperative standing roentgenogram 108'.

4. Congenital scoliosis is seldom progressive and therefore, in most cases, no treatment is indicated. However, the patient should have roentgenograms at regular intervals to be sure that there is no progression. If the curve increases, spine fusion is indicated. Where the curve is high and severe deformity is present because of rib rotation, a partial resection of the affected ribs may give a much improved appearance. This should not be done if the vital capacity is low because respiration may be seriously embarrassed.

5. Neuropathic scoliosis is usually corrected by removal of the underlying pathology. In the spastic child, muscle training and postural exercises are usually sufficient. When the underlying pathology is progressive, fusion is of little avail. Adequate support may, however, prevent severe deformity.

Occasionally adults with clinically stiff curves have pain due to arthritic changes or nerve root compression. Fusion may be necessary and should be done without attempting correction.

That scoliosis is a common condition is shown by the fact that in a period of only

one year (August, 1938 to August, 1939) 174 new patients registered at the scoliosis clinic of the Crippled Children's Hospital. Table 1 shows the distribution of these

FIG. 7. Case J. D. Thirteen months postoperative standing roentgenogram 45'. Notice the change in the rib interspaces.

cases. Of these 174 cases, forty-one or 23½ per cent were fused as is shown in Table II.

TABLE I

Poliomyelitis	103
Idiopathic	34
Empyema	4
Congenital	9
Neuropathic	9
Others	15
	174

TABLE II

Poliomyelitis	24
Idiopathic	11
Empyema	2
Vertebral— Epiphysitis	2
Others	2
	41

Many more of the polio cases now need, or ultimately will need, fusion for prevention of deformity. The relatively large number of idiopathic cases fused is accounted for by the fact that many of these girls wanted correction for cosmetic reasons. In spite of the fact that it was explained to them that there would be no further increase in their deformities, they

insisted on correction and fusion for improvement in their appearance.

In addition to improvement in appear-

will measure the deviation from the normal.

If fusion is decided upon for any of the

FIG. 8. Case L. G. Patient with empyema when scoliosis was first noticed at the age of seven.
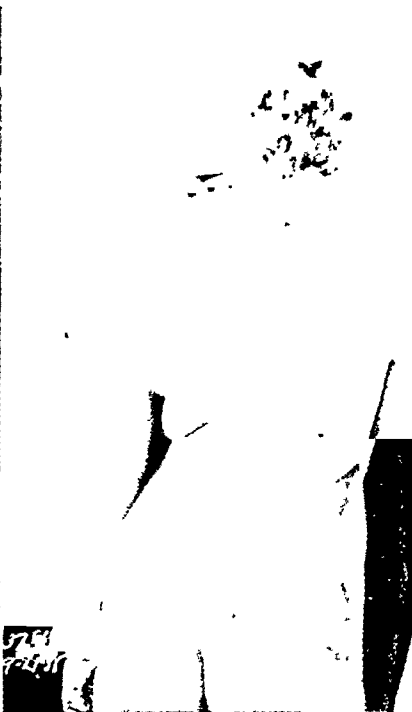
FIG. 9. Case L. G. Preoperative photograph at the age of fifteen.

ance following fusion because of lessened deformity and better balance, there is usually a considerable increase in the patient's height. We have one case with eleven inches and another with seven and one-half inches increase in spine length in patients past the growth period.

The primary curve is usually the middle one of three curves, is less moveable than the compensatory curves and of a greater degree. The extent of the primary curve is measured as follows: Lines drawn across the top of the vertebrae will form radii of a circle. As soon as they form the radii of a new circle the extremes of the primary curve have been reached. This primary area must be included in the fusion or the curve will continue to progress. In the normal spine the top and bottom of all the vertebrae are parallel to one another. Therefore, perpendiculars dropped through the lines at the ends of the primary curve

above listed reasons the mobility of the primary and secondary curves should be determined. We do this by taking supine roentgenograms while the back is being forcibly bent, both to the right and to the left. This is done by attempting to approximate the head to the knee. One film will then show the maximum motion in the compensatory curves, the all important factor in balance. The other film will show the probably obtainable correction in the primary curve. In plaster, usually about twenty degrees more correction can be obtained than on the bending film. If the primary curve does not straighten considerably, there is no point in applying the turnbuckle jacket.

When correction is decided upon, every effort is made to build up the patient by a vigorous regime of sunshine (or ultraviolet light) and exercises. The patient is then admitted to the hospital and the Risser type of jacket is used with certain modifi-

cations. First, the jacket is applied with the patient in maximum bending toward the concave side of the primary curve. This accomplishes three things: (1) the compensatory curves are straightened and the spine converted into one long curve; (2) the compensatory curves thus derotate and it is a fact that the primary curve also derotates as a unit, possibly because of its stiffness; (3) the patient is straighter and therefore more comfortable after correction. Correction is then obtained with hinges and turnbuckles.

Figure 1 shows a simple attachment for the Hawley table, consisting of two malleable steel bars, a plate through which they fit, and a "y" piece. The bars are bent to fit the maximum bending of the patient. Padding is then applied as shown in Figure 2 and the plaster wrapped on. (Fig. 3.) The hinges may either be applied at the same time or the next day. They are place eccentrically at the apex of what is now a single curve in order to obtain some distraction. Several days are allowed for drying and the plaster is cut and wedging begun. Usually only one leg, the one on the convex side of the primary curve, is included in the plaster. But if there is much paralysis about the hips it is better to include both legs to the knees or toes to prevent slipping of the pelvis.

Unfortunately, the wedging jacket allows correction in only one plane, but because of rotation ideal correction is in two planes. Therefore, after correction a second modification of the usual technic is employed. Taking great care not to lose any of the correction, the hinges and turnbuckles are removed and the upper part of the cast is rotated as far as possible so as to bring the shoulder on the convex side of the primary curve forward. This accomplishes two things: First, the rib deformity, or razor back, is lessened; second, the operation is greatly simplified. Formerly in many of the cases with severe deformity the spinous processes lay almost parallel to the table. This made exposure very difficult. Since the derotation method

has been used, the spinous processes have been vertical in almost every case. Many patients want fusion for cosmetic reasons

Fig. 10. Case L. G. Fourteen months postoperative.

and this maneuver gives them a much more satisfactory result. Of course, in long standing cases some of the rotation may be due to deformity of the vertebra itself which obviously cannot be corrected by this method. These cases usually also have a fixed rib deformity. They are greatly benefited by partial thorocoplasty along with the fusion. The rib fragments make excellent additional bone and the operative risk does not seem to be materially increased.

The primary curve must be included in the fusion area or deformity will recur. The fusion area should be between parallel vertebrae in order to maintain balance. When a spine is fused that area is, in effect, made into one vertebra. In a normal spine the top and bottom of each vertebra are parallel in order to maintain balance. We strive to obtain the same condition with fusion. The fusion area is determined from the *immediately preoperative corrected x-ray*

and not from the original film. Therefore, the more correction obtained, the fewer vertebrae will be fused. The back of the

sion of saline and glucose is started with the anesthesia and is continued to 3,500 or 4,500 cc. depending upon the size of the
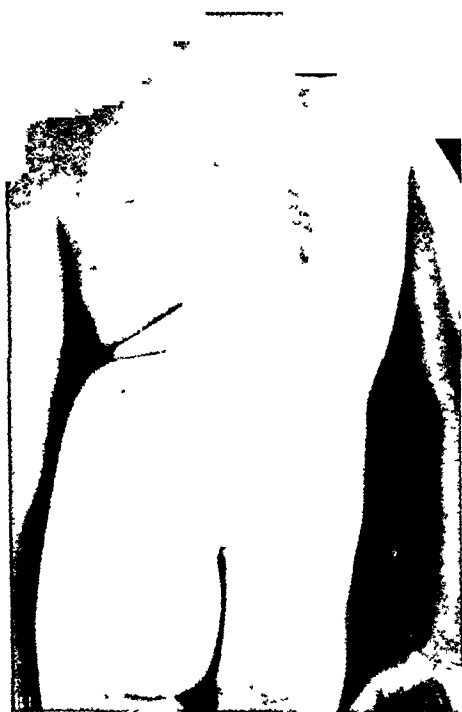
FIG. 11. Case D. L. Preoperative photograph.
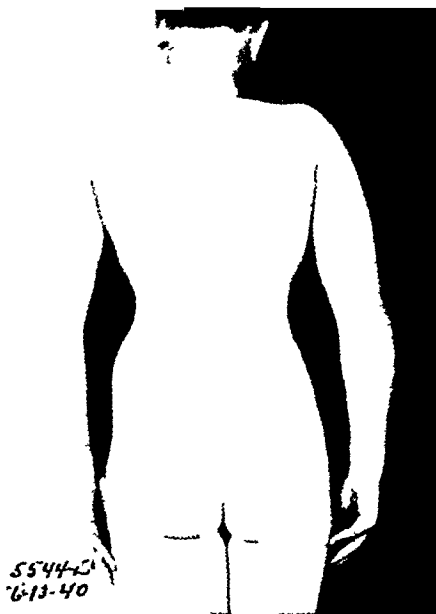
FIG. 12. Case D. L. Nineteen months postoperative.

plaster is then cut out and the patient operated upon by the modified Hibbs or Mackenzie Forbes technic. Six or sometimes seven vertebrae are fused at a time. Additional tibial bone in the form of small chips from the ilium, tibia, ribs or transverse processes is always used.

It seems logical to fuse the lowest part of the curve first because, (1) this area is subject to the greatest strain, and therefore, (2) almost all pseudarthroses occur in this area (from D11 down); (3) when the fusion is started low it can usually be carried across the danger zone in one stage thus avoiding joining at an already weak point; and (4) this usually weak area will be held in plaster at least one month longer than the subsequent fusion area.

For two weeks preceding the operation the patient is given large quantities of stick candy and orange juice to build up the glycogen reserve and increase the vitamin c content of the body. A continuous infu-

patient. Postoperatively the foot of the bed is elevated for twenty-four hours. Cyclopropane is the usual anesthesia but a few cases (one with vital capacity 15 per cent of normal) have been done under regional block. There were no postoperative complications in any of these patients.

The patient remains in the original plaster for three or four months after the last operation, depending upon the amount of force necessary to correct the curve. A second plaster is then applied in recumbency without attempting to straighten the patient for another three months and the patient is allowed to get up. Plaster corsets are then applied at two or three month intervals to make a total postoperative period of from ten months to a year. The last cast is split, buckles are applied, and it is progressively removed over a period of a month while the patient is built up with back and abdominal muscle exercises.

Three cases, one polio, one idiopathic and one empyema will illustrate the treatment. In all the cases the last film was taken after all support had been removed and the patient returned to normal activity.

CASE OF IDIOPATHIC SCOLIOSIS

J. D., age thirteen, was perfectly well until the age of five when a slight curve was noticed. The patient was then placed on a frame for three months followed by braces until admission. There were no significant illnesses or ·family history. Physical examination showed a tall, well developed boy with a marked right dorsal scoliosis with considerable rib deformity. There was a one-inch list to the right, right shoulder one inch high, and right scapula very prominent. (Fig. 4.) The curve was somewhat stiff but still moderately correctible in suspension. In the sixteen months prior to admission the primary curve had increased from 55 to 108 degrees deviation from normal. (Fig. 6.) There was no muscle imbalance or paralysis; leg lengths were equal.

A plaster jacket was applied and correction to 45 degrees obtained in three weeks. Operative fusion took place from D4 to L2 in two stages, three weeks apart. The original plaster was removed in three months and the patient was allowed up in a jacket. Additional jackets were applied over a period of eleven months. The last jacket was split, buckles were applied, and then removed progressively over a period of one month. In the meantime the patient was doing back and abdominal exercises.

His preoperative height was sixty-three and one-fourth inches; after removal of support it was sixty-seven and three-fourths inches. Of this four and one-half inches, four inches of the increase was in the spine. The patient has good lateral motion and can touch the floor with the knees extended.

CASE OF EMPYEMA AND SCOLIOSIS

L. G., age fifteen, had pneumonia at the age of four, after which a left empyema developed and part of the sixth rib was resected in the axillary line. Drainage continued to the age of eight. At seven a scoliosis was noticed, as shown in Figure 8, which in seven years progressed from 19 to 74 degrees. At the ages of eleven and twelve plaster casts were applied

for two months each. The patient was then put in a brace for the next three years. Examination showed a well developed girl who not only had a two and one-half inch list to the right, but had a rotation of the upper trunk to the left. (Fig. 9.) There was severe .rib deformity with prominent scapula and ribs on the right, exaggerated flank crease and prominent hip on the left, and right dorsal scoliosis with primary curve D3 to D11 fairly well fixed but with some correction on suspension. There was no muscle weakness; leg lengths were equal.

Correction in plaster was secured to 19 degrees in three weeks. Spine fused from D1 to L1 in two stages four weeks apart. The patient was kept in the original plaster four months. She was allowed up with several changes of plaster to eleven months. The jacket was split and progressively removed over one month while the patient did exercises. At this time there was an excellent range of lateral motion and the patient could touch the floor with the knees extended. Preoperative standing height was fifty-nine and one-half inches, after removal of support sixty-three and one-half inches. There had been no leg growth. (Fig. 10.)

CASE OF POLIOMYELITIS AND SCOLIOSIS

D. L., age sixteen, had poliomyelitis at the age of nine with lower extremity and marked abdominal paralysis. Scoliosis was noticed at the age of twelve. At thirteen a right Lowman transplant was performed. The patient was markedly improved and could now sit and stand without support. There was rapid progress of the scoliosis. Examination showed a fat, poorly developed boy. There was right dorsolumbar scoliosis D6 to L2 of 94 degrees. (Fig. 11.) There was a one and one-half inch list to the right, high shoulder, exaggerated flank crease, prominent hip on the left, and a moderately severe right rib deformity. Leg lengths were equal. Right oblique and rectus abdominis were absent. Right quadriceps weakness and anterior tibial paralysis were present.

Correction in plaster to 28 degrees obtained in three weeks. Fusion from D4 to L3 in two stages took place four weeks apart. Original plaster was removed in four months and patient was allowed to get up. In eleven months the jacket was split and progressively removed over five weeks while the patient did exercises.

On forward bending hands come within one foot of the floor. Preoperative height was fifty-nine inches; at present sixty-six and one-half inches without any leg growth. (Fig. 12.)

SUMMARY

The author's experience with scoliosis has been discussed including 174 cases seen during a one-year period. The importance of determining the etiology has been stressed because it is the most important factor in prognosis and treatment. Both the conservative and operative management have been discussed and three cases are presented to illustrate the treatment.

Scoliosis is therefore considered a condition in which deformity can be prevented by proper treatment in the early stages, and can be definitely improved in the later stages. The physician should not be discouraged because the treatment is difficult and time consuming, for he will receive ample reward for his labors from the mental and physical improvement in his patients.

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GUIDE FOR INTERNAL FIXATION OF INTRACAPSULAR AND INTERTROCHANTERIC FRACTURES OF THE FEMUR*

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THE use of internal fixation for intracapsular and intertrochanteric fractures of the femur has increased the

FIG. 1. Upper end of guide placed at junction of greater trochanter with shaft of femur (femur internally rotated 20 degrees). Handle of guide in horizontal plane. Drill holes made into neck of femur and replaced by double screws.

need for an efficient guide to facilitate accurate placement of screws, nails or wires. After considerable experimentation, the guide pictured in the accompanying illustrations was devised. Such a guide simplifies the technic of operation and decreases the operating time by reducing the number of x-ray films necessary to determine whether the screws, nails or wires are in their correct positions. Both of these factors are of vital interest to patient and surgeon.

DESCRIPTION OF GUIDE

The guide consists of a metal frame with V-shaped ends, both notched at the bot-

tom. (Fig. 1.) When the instrument is placed on the bone, one end is held against the greater trochanter at its junction with

FIG. 2. Top piece of drill or wire director removed. Entire guide is then removed and both screws are driven into head of femur.

the shaft, and the other end fits on the shaft of the femur. The rough, notched edges of the V-shaped ends catch in the periosteum and prevent slipping of the instrument.

The guide is held against the femur by a handle (Fig. 1), which also serves the purpose of showing that the guide is in the horizontal plane. The handle is removable and can be screwed in at several points so that it will not be in the way of the operator.

A director, consisting of a square piece of metal placed midway between the two V's, guides the wire or drill into the neck of the femur. It turns on a pivot and can be set at any angle by a screw on the undersurface of the frame. (Fig. 3.) A needle on the director
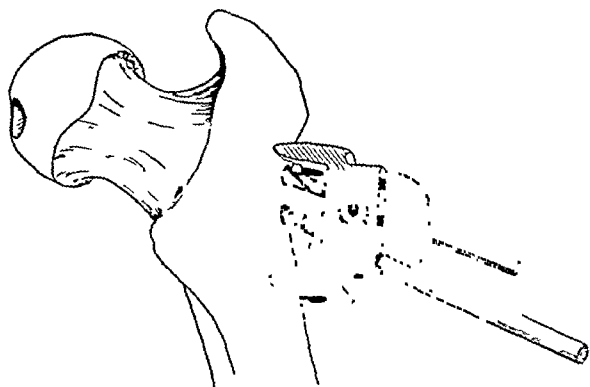
FIG. 3. Undersurface of guide. Set screw allows drill or wire director to be placed at any angle desired. By turning guide director, it may be used for either hip.
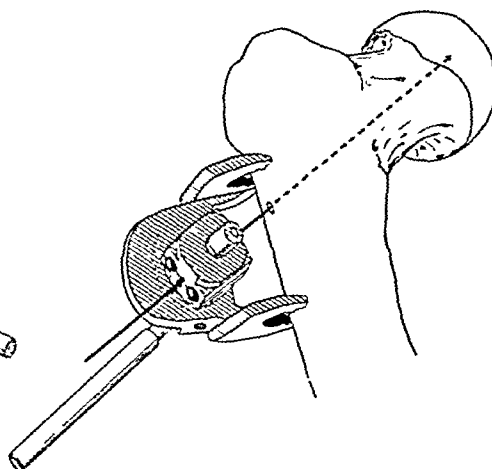
FIG. 4. Guide in place. Wire inserted into neck of femur. Smith-Petersen nail may be threaded over the wire.
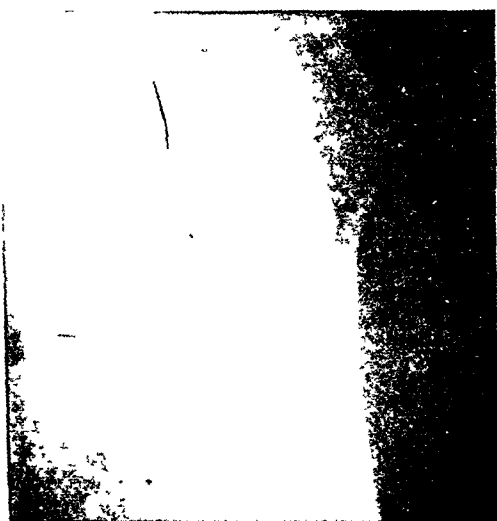
FIG. 5. Roentgenogram showing intertrochanteric fracture.

FIG. 6. Roentgenogram: anteroposterior view showing double screws into head of femur.

FIG. 7. Roentgenogram: lateral view, showing both screws into head of femur.

points to a scale on the frame to indicate any desired angle. The director is equipped with three openings, so that either double

METHOD OF USE

The fracture must first be properly reduced. The extremity is held in slight

FIG. 8. Roentgenogram showing wire into head of femur.
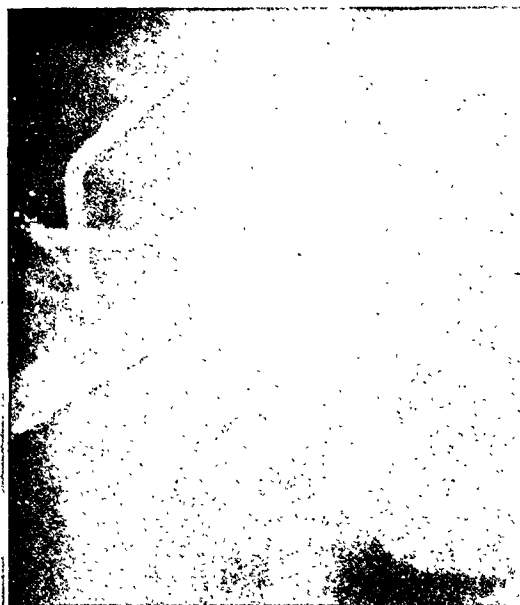
FIG. 9. Roentgenogram: anteroposterior view showing Smith-Petersen nail into head of femur.

screws or a single wire can be inserted into the neck of the femur (Fig. 4), and is in two pieces horizontally so that the top half can be removed when screws are used, to allow the screws to be driven into the head.

abduction and internal rotation of about twenty degrees. This amount of internal rotation places the femoral neck on a horizontal plane. With the extremity in this position, an incision is made approximately
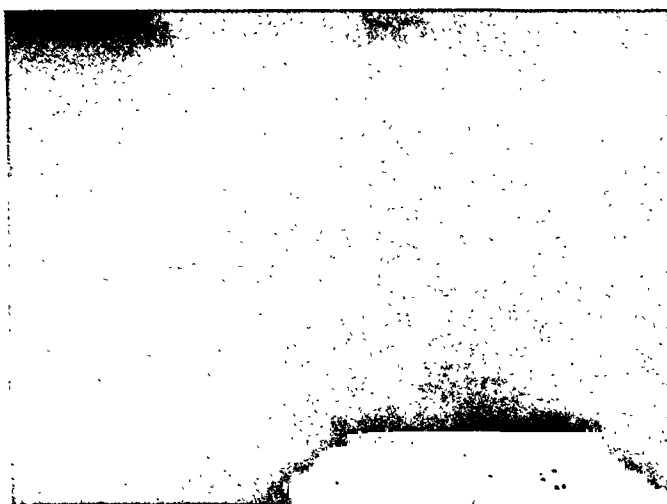
FIG. 10. Roentgenogram showing lateral view of Smith-Petersen nail into head of femur.

(Fig. 2.) If a wire is used, the guide slips off by simply pulling it away from the femur.

The instrument can be used for either right or left femur by merely turning the director to the opposite side and reversing the ends of the guide.

four to six inches in length over the lateral aspect of the greater trochanter, exposing it and about three inches of the shaft of the femur.

The guide is set at 127 degrees. It has been found by measurement of a large

number of femurs that the individual differences are not great, the shaft neck angle being approximately 127 degrees and about twenty degrees in the horizontal plane. On cross section, the neck of the shaft is approximately 1.8 to 2.5 cu. in. in diameter.

One end of the guide is placed just at the junction of the greater trochanter with the shaft, the other end on the shaft of the femur (Fig. 1), the handle of the guide being in a horizontal plane. A drill or wire is introduced into the neck of the femur. A roentgenogram is made to check the position of the drill or wire.

If double screws are used, the drill is removed and replaced with a three inch screw, and another drill hole is made parallel to the first. The drill is again removed and replaced with a three inch screw. Both screws are driven in as far as the guide will allow. The top half of the director is removed (Fig. 2), and both screws are driven into the head of the femur.

If a Smith-Petersen nail is used, a wire is inserted into the neck of the femur (Fig. 4), the guide is removed by simply pulling it away from the femur and the cannulated nail is then threaded over the wire and driven into the head of the femur.

The wound is then closed. The position of the drills is again checked by roentgenogram, this time from the lateral view. So accurate is the placing of the drills by the guide that the lateral view is taken after the operation.

Sufficient use of the guide has been made to warrant recording our experiences with it. It has been employed in thirty-eight instances and at no time has the head of the femur been missed in either plane. The use of the guide has eliminated the element of rough gaging of the position of the head and, in our experience, has reduced the operating time to thirty-five or forty minutes.

ANALYSIS OF FORTY-SIX CASES OF ACTINOMYCOSIS WITH SPECIAL REFERENCE TO ITS ETIOLOGY*

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THE Actinomyces bovis has been established by Wright[1] since 1905 as the causative organism of actinomycosis. However, there still remain many points unsolved in its pathogenesis. Biological research has continued to make new contributions[2] in an attempt to answer some of these debatable points. Yet, in the light of this newer knowledge there has been no comprehensive clinical study of any large group of cases of antinomycosis in this country for the past ten years.

In view of these facts it was considered an appropriate time to review the cases of actinomycosis occurring in the University Hospital in the past ten years. It will be the purpose of this paper to analyze these cases with special reference to: (1) their bearing on the mode of infection of the disease, (2) the results of treatment especially in the cervical cases and (3) to bring up to date our knowledge of the pathogenesis of actinomycosis.

Actinomycosis is an infection characterized by the usual presence of lesions composed of abundant granulation, or connective tissue surrounding multiple areas of abscess formation and by the presence within the abscesses of branching, Gramstaining, filamentous, anaerobic organisms with radially-disposed, club-bearing filaments.† The disease has been fully described by many observers. Ruhrah[3] collected fifty-eight American cases in 1899. This number was brought up to a hundred by Erving[3a] in 1902. In 1922 Sanford[4] was able to collect almost 700 unreported cases in this country.

In a ten year period, 1926 to 1936, there were forty-six cases of actinomycosis in the University Hospital. Thirty-two of these cases were confirmed either by finding sulfur granules in exudate from the lesions and the demonstration microscopically of the ray fungus, or by similar findings of the club-bearing filaments in biopsy specimens or at autopsy. A follow-up study was made and twenty-two patients were heard from.

GEOGRAPHIC DISTRIBUTION

In Michigan, as shown by Sanford's[4] complete survey, there is not the greatest incidence of the disease, but it is located in that portion of the Northwest where there are a greater number of cases seen than in any other part of the country, except the states of New York and Massachusetts. However, it is probable that this greater prevalence of the disease in any one locality is only apparent and may be due to greater interest in and familiarity with the disease in that particular locality.*

McKenty[5] noted that all but several of his thirty-seven cases came from within a radius of one hundred miles of Montreal. Earlier writers have suggested this endemic nature in reports of actinomycosis in cattle where certain herds of cattle fed in particular salt marshes. This endemic character of the disease has also been noted where the infected animals were known to be feeding on a certain batch of grain (Jensen); but Johne[5] in 1888 fed cattle on food infected with cultures of the organism and none became infected.

† Definition given the author by F. T. Lord.

* F. T. Lord: Personal communication to the author.

Our group of cases was fairly well distributed over the state with a few cases from nearby states. There was no evidence of endemicity.

An interesting point was the fairly even distribution between rural and urban population, a point which has not been mentioned in other reports.

AGE AND SEX

Most writers agree in describing actinomycosis as occurring in middle age. A comparison of age distribution is made in Table I with that reported in other groups. Eighteen, or thirty-nine per cent occurred in persons past midlife which seems to be an unusually high percentage of occurrence in people in the higher age bracket.

TABLE I
COMPARISON OF AGE DISTRIBUTION WITH THAT GIVEN IN OTHER REPORTS

Name	No. Cases	Age, Per Cent				
		20	50-25	35-25	45	Past 40
Sanford and Magath*	119 / 96					60
New and Figi	107		70			
McKenty	37				60	
Erving.	100			64		
University Hospital.	46					39

* One hundred nineteen collected cases and ninety-six Mayo Clinic cases.

As in other reports there was a marked preponderance of males over females, a well accepted characteristic of the disease.

ANATOMIC DISTRIBUTION

It is generally conceded that the majority of actinomycotic infections occur in the cervicofacial region. This is well demonstrated in the accompanying comparative Table II, showing the sites of election for the disease as found by other observers. In our group there were equally as many cervicofacial cases as there were thoracic and abdominal cases together.

Among the cervicofacial cases were two primary infections of the tongue, previously reported from this department.[6] In two instances actinomycotic-like organisms were found on pathologic examination of tissue, occurring as a secondary invader at the edges of a wound.

TABLE II
COMPARISON OF UNIVERSITY HOSPITAL CASES WITH THAT OF OTHER REPORTS IN RESPECT TO ANATOMIC DISTRIBUTION

Name	No. Cases	Head and Neck	Thorax	Abdomen	Skin
Sanford and Magath*	119 / 96	62 / 64	16 / 4	9 / 3	
Coller	50	26	5	17	
New and Figi	107	65 16	70	20 30	
McKenty	37	19	2	16	
Erving	100	53	20	23	
University Hospital	46	23	9	14	

* One hundred nineteen collected cases and ninety-six Mayo Clinic cases.

MODE OF INFECTION

For thirty years two widely different views have been prevalent concerning the mode of infection obtaining in actinomycosis. On the one side, there are those who believe that the organism gains entrance to the body through grasses, grains, etc., upon which the organism lives in the outside world and by means of which the infection is carried to the tissue. Contact with "lumpy jaw" in animals is also considered a source of infection. More recently vegetables packed in straw have been suggested as another possibility.[7,8] This theory is upheld by the followers of Boestrom, who in 1890 isolated a streptothrix, which was apparently identical with an aerobic organism found widespread in nature, upon grasses and grains. This theory is further supported by the fact that many cases are reported in which barbs of barley or grain have been found in the lesions of men and animals, and many instances in which there is a history of swallowing a blade of grass

The followers of this theory also take the reports of instances of endemic actinomycosis among cattle fed on certain fields of grain as further evidence in support of their theory.

There is an opposing theory, based on the well known and accepted work of Israel and Wolff,[9] later Wright,[1] and others, demonstrating that the organism causing true actinomycotic lesions never grows on grasses and grains and has quite different cultural characteristics from that of Bostroem.[14] Actinomyces bovis is a facultative anaerobe, difficult to grow, grown only at body temperature. These facts have given rise to the view upheld by Wolff and Israel,[9] and Homer Wright,[1] as well as by Lord,[10] and Naeslund,[11] that the Actinomyces bovis does not have its usual habitat in the outside world on grain and grasses, but normally inhabits the digestive tract, particularly the mouth, where it remains as a saphrophyte. Given the proper conditions of a lower resistance and portal of entry, the organism becomes pathogenic with the production of a lesion.

OCCUPATION

It is commonly stated that the disease is more common in those handling hay or those who come in contact with animals afflicted with "lumpy jaw." However, in reviewing the reports with this particular point in mind, it would seem that the actual facts do not substantiate this generally accepted impression.

Sanford and Magath[12] reported on 119 collected cases, and ninety-six cases from the Mayo Clinic; of their 119 collected cases only sixteen were farmers (one-quarter not noted). In Sanford's[4] 678 collected cases, 50 per cent only were in contact with cattle or in occupation which predisposed them to infection. Furthermore, there was no definite relationship noted between the distribution of the disease in the entire country and the distribution of the prevalence of diseased cattle. In Mckenty's[5] thirty-seven cases, nineteen were farmers, one a grain merchant and

two gave history of contact with infected animals. Mattson[7] is of the opinion that infection is acquired from animals in a goodly number of instances. In twenty-six answers to questionnaires he found fifteen patients gave a history of treating animals with "lumpy jaw." New and Figi[13] likewise through eighty answers to a questionnaire reported that while thirty-five or 43.7 per cent had been associated with the disease in animals, forty-five or 56.1 per cent had not come in contact with diseased cattle. However, the time elapsing from the time of exposure, to the recognition of onset of symptoms, averaged five and one-half years, varying from six months to twenty-five years. They concluded that the probability of direct infection from cattle was questionable. Rather, they felt that the presence of "lumpy jaw" in cattle in the neighborhood from which patients with the infection came, probably indicated that the organisms were abundant on the vegetation of the locality, rather than that the diseased animals were the primary cause of the infection in man.

Contagion from man to man has never been definitely established.[14] Ochsner's[14] two well known cases are usually cited as examples of this occurrence. In one instance the man drove a horse with "lumpy jaw," in the other the patient had handled infected cattle. There is one case reported in which infection is presumed to be transferred from man to man. This is McKenty's[5] case of a nurse who was infected by administering to a patient with actinomycosis. But McKenty himself states that the proof was not convincing.

Though Mattson[7] leans toward the frequency of the transmission of the disease from animal to man, he cites Salmon's experiment of placing twenty-two infected cattle with healthy cattle for four months, without any of the well cattle becoming infected, which is certainly convincing evidence against infection by contact. As Cahill[15] has stated, the disease is not contagious, being exceedingly difficult to

produce the disease by injecting infected pus into animals.

Only fifteen of our forty-six cases were farmers, or less than 35 per cent. The remainder were divided among laborers, professional men, mechanics and clerks. Eleven were classified as unemployed.

A questionnaire was sent to twenty-six of our patients in which they were asked the question. Had they at any time come in contact with animals who had "lumpy jaw" or similar infections? To this question sixteen answers were received, all in the negative.

HABIT OF CHEWING GRASS

That actinomycosis is contracted through the introduction into the oral cavity of straw, grain and grasses which are infected, has been handed down to medical students through classroom and textbooks for the past fifty years.

There are numerous instances in the literature in which infection is said to have followed the chewing of grass, or the swallowing of a blade of grass, or again where infection has occurred through injury of the oral mucous membrane by a barb of barley or beard of grain. Such is Cope's[8] case of a child of ten, who developed an actinomycosis of the jaw after swallowing a blade of grass which stuck in the tonsil. Soltman[7] had a similar case in which a youngster developed actinomycotic abscesses in the chest after swallowing a barley awn, which was later found in the pus from the abscess. New and Figi[13] reported the history of a foreign body in five of their cervical cases, and there have been similar reports by others. In all these reports, however, it must be noted that such instances only make up a very small percentage of any one group of cases.

Colebrook[16] and Lord[2] have both expressed skepticism, regarding any view which considers the infection as being introduced through such a mechanism as these cases would indicate, as the organism, which is commonly found on vegetable sources, is an aerobic fungus, not conform-

ing bacteriologically to the type of organism used to describe this group. The anaerobic organism of the type of Actinomyces bovis has never been demonstrated unquestionably in natural sources outside the human body; they postulate, therefore, that anyone who adheres to the idea that the organism of actinomycosis is introduced into the body by vegetable matter, must presuppose his own hypothesis as to how this organism existed before entering the human body. There is no biological evidence to substantiate any of these hypotheses, such as existence of a spore formation in the life cycle of the organism.

Mattson[7] is the only one who gives definite figures on patients concerning their habit of chewing grass or grain. He states that of twenty-six patients asked this question in a circular letter, eleven answered in the affirmative.

Of our forty-six cases there were only three who gave a history of chewing grass or straw. Circular letters were likewise sent to twenty-six patients, and in answer to the question, "Have you ever been in the habit of chewing on straw or grass?" there were none who admitted this habit.

Epstein[17] has recently stated that the theory that the disease is contracted by chewing straws, grasses, etc., is not well founded, and from a clinical standpoint the hypothesis in many cases does not fit the clinical history. Our findings bear substantiation of this clinical impression which has also been voiced by others.[2,10,12] Thus it may be that a very old idea handed down through the textbooks might need revision.

DENTAL ORIGIN

Homer Wright[1] showed that the true actinomycosis described by Israel and Wolff,[9] in 1878, is not found outside of the animal body, and the etiological relationship of the organism of the Wolff-Israel type to actinomycosis is now regarded as established. For this reason Wolff and Israel, as well as Homer Wright,[1] Lord,[10] and Naeslund,[11] have at various times expressed the belief that the Actinomyces

bovis is a natural inhabitant of the gastro-intestinal tract, especially of the mouth.

Origin of the disease from organisms normally harbored in the buccal cavity is further suggested by finding in carious teeth and tonsillar cysts of normal people, smears, and sereal sections showing organisms with the morphology and staining reaction of actinomyces.

In examination of 10,000 tonsils Wilkson[18] found bodies which resembled those found in cases of actinomycosis in 177 cases. Actinomycosis occurred second in order of frequency among the pathologic conditions found in the tonsils examined. These were believed to be of the non-pathogenic variety, however. Weller[19] in examination of 1,000 tonsils found forty-seven out of eighty positive cases of tonsillar concretions of the crypts to be actinomyces-like colonies of mixed mouth organisms.

Lord[1,20] noted in the sputum from patients without clinical evidence of actinomycotic infection, the occasional presence of organisms with the morphology and staining reaction of actinomyces. He likewise observed that patients with actinomycosis often gave a history of previous trouble with their teeth. Knowing the failure of actinomycosis to grow at other than body temperature and the lack of evidence of its contagiousness, the fact suggested itself to him that the disease arises from within rather than from without the individual.

Thus in 1910 Lord[20] inoculated guinea pigs intraperitoneally with the contents of carious teeth of patients without actinomycosis and produced omental tumors in 60 per cent, histologically identical with actinomycotic tissue, and containing typical club-bearing actinomyces granules. Lord[20] later noted that similar lesions were produced in animals inoculated with the scrappings from sound teeth. An attempt to isolate the organism in pure culture, however, failed. These findings furnished evidence in favor of the buccal cavity as a normal habitat of Actinomyces bovis. To prove the identity, however, of the organ-

isms found in the mouth with Actinomyces bovis, it would be necessary that pure cultures be obtained, as certain strains of streptothrix are capable of forming similar appearing colonies when inoculated into animals. It was this point in the failure of the experimental work, to which Mattson[7] pointed in 1922 as showing the unliklihood of true actinomycosis being present in the mouths of normal persons. However, in 1925 Naeslund[11] confirmed Lord's findings, and produced experimentally in animals, lesions histologically identical with actinomycotic tissue and containing club-bearing actinomyces granules, by the inoculation of animals with material obtained from the normal mouth. He was further successful in isolating from the normal mouth anaerobic organisms morphologically and culturally like the actinomyces of the Wolff-Israel type. He was later able to produce with these cultures lesions in animals characteristic of actinomycosis. This establishes the fact that antinomyces of the Wolff-Israel type is present in normal mouths and is a long step forward toward substantiating Wright's theory that the organism is a normal inhabitant of the oral cavity.

That the disease may arise from organisms normally found in the oral cavity, has been suggested by a number of writers and investigative workers. Many observers have noted and commented upon the greater frequency, with which the disease occurs in the head and neck than in any other portion of the body. Likewise there has been noted the unusually large number of cases in which carious teeth are found present in the mouth, or in which there was a previous history of some difficulty with the teeth. Sanford and Magath[12] in ninety-six cases reported from Mayo's, noted in almost all cases, a history of preceding tooth or tonsil trouble. They concluded that the alimentary tract played a very important part in the source of infection. Ruhrah[3] noted that carious teeth, in which the lower jaw is involved, seemed to play an important rôle. In McKenty's[5] thirty-seven

cases, of those in which a history was given, there were eight following extractions or infected teeth. New and Figi[13] concluded that the organism of actinomycosis is probably a common inhabitant of the normal mouth. Coller[21] likewise noted the finding of carious teeth, and that the infection was not uncommon following tooth extractions. Warwick[22] describes the case of a woman who a few months following aspiration of a tooth developed a thoracic actinomycosis. There are also two cases, one of Cope[8] in England, and one of McWilliams[7] in this country, in which actinomycosis of the finger developed in each instance, following a human bite by a person without actinomycosis.

In seven of our cases, infection was preceded by only a few days to a few weeks by the extraction of teeth. In one case there was a history of an abscessed tooth, and in another instance actinomycosis was found in the pathological examination of the tonsils without evidence of infection elsewhere in the body.

It is usual to consider that some break in the tissue precedes the infection and acts as a portal of entry. There was, however, an unusually large number of cases in which it was impossible to point to a break in the skin, or mucous membrane preceding infection. Eighteen cases, or 39 per cent of the group may be included in such a classification.

In four abdominal and thoracic cases, and three cervical cases, there was a history of onset of infection following a severe blow to the body but without causing an actual break in the continuity of the tissues. Six abdominal and thoracic cases were preceded by appendectomy, a well known occurrence. It would seem that either a microscopic break in the tissue is necessary or that the tooth in many instances acts as an area of lowered resistance.

RESULTS OF TREATMENT IN THE CERVICAL CASES

It is the general experience of most observers that the prognosis in the cervical cases is far more favorable than in the abdominal and thoracic infections.

McKenty[5] treated nineteen cervical cases; of these four were not traced, two showed no improvement and one was chronic over an eight-year period, dying of a chronic nephritis with freedom of nine months from actinomycosis. Of twenty-one cervical cases treated by Mattson[7] twelve were entirely cured, seven were improving when heard from. His mortality in appendiceal and pulmonary cases was 100 per cent in six months to a year. New and Figi[13] traced eighty-five of their patients of whom thirty-six were well for one to five years. Seven had died, and in twenty-four the condition was not stated.

For numerous reasons, the interval between the time the patient was aware of symptoms and the time that he presented himself for treatment was in most instances quite long. Only one patient was seen in which the infection had been present less than a month. Eight were not examined until the lesion had been present six months or longer. The interval varied in the remaining seven patients from one to six months.

A ten year follow-up study was made on twenty-two of our cases. This consisted of thorough re-examination in the clinic and when this was impossible by follow-up letters. The results are striking. Of the total twenty-three abdominal and thoracic cases originally seen, all but one had died at the end of fourteen months, and the one still living had active lesions in the chest at the end of one and one-half years. Of those sufficiently well to leave the hospital, seven months was the average length of time before death.

Results in the cervical cases present a brighter picture. Of the total twenty-three cervical cases treated at the University Hospital during the past ten years fifteen were followed. Of these all but one was cured on an average of two and one-half months after discharge from the hospital. The length of time required for healing varied from ten days, following discharge

from the hospital, to six months. One patient died of a condition unrelated to his infection, which was healed at the time of death. One patient had a lesion present on the cheek for ten years and finally died with generalized metastases.

For these reasons the biologist believes the organism of actinomycosis to be a natural inhabitant of the digestive tract, especially the mouth, and believes that the infection is introduced into the body from outside sources. There is no biological evi-

TABLE III

RESULTS OF TREATMENT OF 46 PATIENTS WITH ACTINOMYCOSIS WITH TEN YEAR FOLLOW-UP STUDY ON 22 CASES. DATA ON RESULTS OF TREATMENT IN OTHER LARGE GROUPS OF CASES IS GIVEN

Name	Total	Type	Cured	Improved	Chronic	Died	Not Followed
McKenty	19	Cervical	12	2	..	..	4
Mattson	21	Cervical	12	7	..	..	2
Figi	85	All types	36	..	..	7	24
University Hospital	46	Cervical	14	..	..	1*	8
		Abdominal thoracic	..	..	1	22	

* Actinomycosis of cheek present for ten years. Died of generalized spread. There were two cases of several years' cure, in which there was death from entirely unrelated causes. These cases were considered as cured.

Treatment in the University Hospital both on the dermatological and surgical services consists of Lugol's wet dressings, iodides to tolerance, plus x-ray and surgical drainage when indicated.

In reviewing the results of these cases the malignant nature, the frequency of metastases and the high mortality in abdominal and thoracic cases as compared with cervical infection showed the same disproportion as given in other reports.

SUMMARY

The theory that actinomycosis is contracted by chewing straws, grasses, etc., is at variance with the present day biological and bacterological concept of the mode of infection of this disease. An attempt has been made to correlate clinical findings with the facts now well established by the laboratory.

It is now a definitely established and accepted fact that the true causal organism of actinomycosis is an anaerobe, never found growing in the outside world. Furthermore, it has been cultured from the mouths of normal individuals with the subsequent production of typical actinomycotic infection in the tissues of laboratory animals.

dence to support the hypothesis that actinomycosis is introduced into the body by vegetable matter.

Findings in our own cases and in that of collected material would tend to show that the habit of eating grass, the proximity to infected animals, and special types of occupation, things which we have heretofore associated with the mode of infection of actinomycosis, are probably present considerably less than 50 per cent of the time.

Although sufficient material has not been presented upon which to make any definite conclusions, clinical findings have been given which would at least question whether there is need for a revision of our ideas of the mode of infection of actinomycosis.

Actinomycosis is still a relatively rare infection, there being only forty-six cases seen in a period of ten years, or less than five cases per year, and this in a portion of the country in which actinomycosis is purported to be relatively prevalent.

The fairly even distribution of actinomycosis between the rural and urban population is noted for the first time.

A relatively good prognosis is indicated in the cervicofacial cases as evidenced from the results obtained in treatment of such

cases whereas the outlook in thoracic and abdominal cases is extremely grave.

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CLINICAL OBSERVATIONS ON SOME SYSTEMIC EFFECTS OF PITRESSIN*

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PITRESSIN,† the pressor principle of the posterior lobe of the pituitary body, is a hormone known to cause contraction of smooth muscle.[1] Because of this action it has been recommended and employed for the prevention and treatment of postoperative abdominal distention, urinary bladder atony and arterial hypotension.

Unlike cholinergic drugs which cause smooth muscle contraction through the intermediary of acetylcholine at the neuro-effector cell, the pressor effect of pitressin is exerted directly upon smooth muscle. The end result on most of the autonomic tissues, is not unlike parasympathetic stimulation.

This report is an analysis of clinical observations concerning the effects of pitressin on the principal autonomic systems: (1) the gastrointestinal tract, (2) the cardiovascular system, and (3) the respiratory system. Therapeutic doses of the drug were administered hypodermically to patients prior to, during and following abdominal surgical interventions.

1. EFFECTS ON THE GASTROINTESTINAL TRACT

Intestinal contraction can be observed directly in the opened abdomen five to ten minutes following the intramuscular injection of a therapeutic dose of pitressin. It is this effect which has prompted the use of this drug in the prophylaxis and treatment of postoperative abdominal distension.[2]

Coincident with intestinal contraction is peritoneal relaxation. This effect may be

† Manufactured by Parke, Davis and Company.

very striking and seems analogous to the relaxing effect reported by Garrelon[3] following the administration of physostigmine in cases of resistant abdominal rigidity during celiotomy.

2. CARDIOVASCULAR EFFECTS

Most of the untoward effects observed following pitressin therapy have been circulatory reactions of the depressive type usually characterized by pallor and fall in blood pressure with its implicative symptoms.

Laboratory studies on the cardiovascular effects of pitressin have been numerous. Gruber and Kountz[4] have shown that it affects the dog's heart in several ways: first, it acts through the vagi by stimulation of the cardio-inhibitory center; second, it causes constriction of the coronary arteries with resultant asphyxia of the myocardium. In addition there are changes in the conductive system resulting in partial heart block, shifting of the pacemaker and sino-auricular block. Mellville[5] confirmed the coronary constricting action of pitressin and suggested that it is the cause of the other cardiovascular effects. Ross, Dreyer and Stehle[6] have likewise found that coronary spasm is at least one of the important factors which may cause a fall in blood pressure. More recently, Katz and Lindner[7] concluded from their studies that "the occurrence of powerful constriction in the coronary vessels following pitressin suggests the possibility that coronary spasm can and may occur in man."

The following case report illustrates a circulatory effect following the administration of pitressin:

CASE I. Laparotomy was proposed for the removal of a Miller-Abbott tube impacted in the transverse colon. The patient, a woman of

at which time the operation was completed. Excess oxygen was administered in view of the respiratory distress but seemed ineffective. The
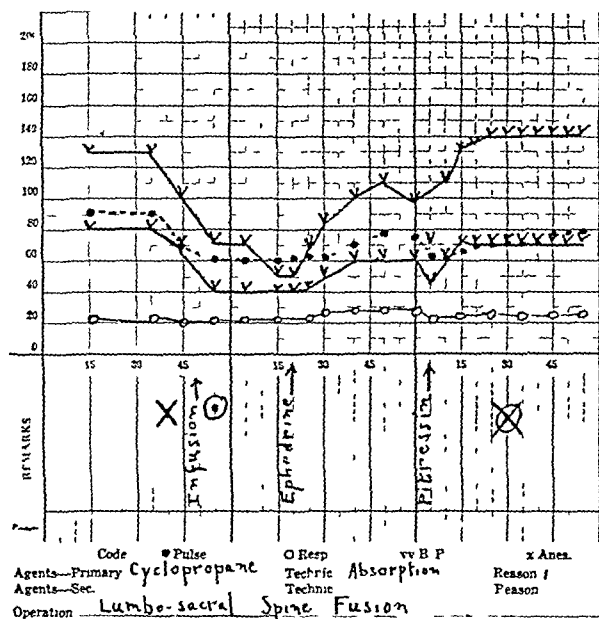
FIG. 1. Effect of pitressin on arterial pressure following the preliminary administration of ephedrine.

fifty-seven, was greatly debilitated from the unsuccessful attempt to pass the tube for relief of postoperative intestinal paralysis. The pre-operative arterial pressure was 90/50 mm. Hg and the pulse rate was 120. Anesthesia was induced using cyclopropane with a closed endotracheal technic. During celiotomy the end of the Miller-Abbott tube was found impacted in the transverse colon and the proximal part of the gastrointestinal tract was ruffled about the tube with numerous perforations of the stomach and intestine. Ten minutes after surgery was begun the arterial pressure had fallen to 70/50 mm. Hg. An infusion of 1,000 cc. of a 5 per cent solution of glucose in saline was started with resulting temporary improvement. After an hour and a half, however, the arterial pressure fell progressively to 60/45. A 500 cc. blood transfusion was started and pitressin ½ cc. (10 units) was slowly injected intravenously to counteract the low blood pressure and to stimulate intestinal contractions. Within five minutes marked pallor developed while the arterial pressure showed a significant rise to 120/60. Then, in spite of the presence of a patent endotracheal airway with excess oxygen available, the patient began to use her accessory muscles of respiration. The arterial pressure fell to 60/50 mm. Hg in a half hour

pulse became rapid and thready and the patient expired 20 minutes after the operation was completed.

The pathology presented by the patient revealed a fatal prognosis but this case indicates the inadvisability of intravenous pitressin administration even in minute doses.

There is evidence to indicate that the depressive circulatory effects of pitressin secondary to coronary constriction may be prevented by the preliminary administration of ephedrine.[7] Clinical observations seem to substantiate this effect as the following case report illustrates:

CASE II. (Fig. 1.) F. L., a woman of thirty-five, had a pseudarthrosis of the lumbosacral spine for which a spine fusion was proposed. Physical examination revealed no other defects than a marked dermographia and considerable apprehension. On the day of operation, morphine sulfate 0.010 Gm. (gr. ⅙) and scopolamine 0.00048 Gm. (gr. 1/150) was administered subcutaneously at 7:45 A.M. The patient became unusually pale and during the next hour was nauseated and vomited several times. The

arterial pressure, taken at 8:35 A.M., just prior to the administration of anesthesia, was 130/80 mm. Hg and the pulse rate was 92 beats per minute. Cyclopropane anesthesia was begun at 8:40. A routine infusion of 5 per cent glucose in saline was given at 8:50. At 8:54 when the operation was started the pulse rate had decreased to 60 beats per minute and the arterial pressure showed a surprising fall to 70/40 mm. Hg. Ten minutes later the pulse rate was 58 and the arterial pressure 52/40. The patient's color was natural, respiratory movements were of normal rate and amplitude and the skin was warm and dry. However, because of the circulatory depression, ephedrine sulfate, 50 mg., was administered subcutaneously. During the next thirty minutes the arterial pressure rose gradually to 110/60 mm. Hg and the pulse rate increased to 78. But after fifteen minutes the arterial pressure had fallen again to 70/40 and the pulse rate had decreased to 58. One cc. of pitressin (20 units) was then injected intramuscularly. The arterial pressure rose to 140/70 within ten minutes and it remained at this level until the termination of the operation. Postoperatively, the arterial pressure stayed remarkably constant between 130/70 and 138/70 mm. Hg for several days.

This case indicates the beneficial effects of the pressor action of pitressin, preceded by ephedrine, in a patient with apparent autonomic nervous system imbalance, characterized by seemingly sympathetic depression caused by general anesthesia. The sympathetic hyperactivity manifested by this patient in the wakeful preoperative state consisted of marked apprehension, tachycardia, pallor and dermographia. When consciousness was lost under anesthesia, the autonomic imbalance was further disturbed as evidenced by bradycardia and marked hypotension. A therapeutic dose of ephedrine resulted in only temporary improvement. The administration of pitressin then showed more rapid and better amelioration which was maintained.

In cases of active celiac plexus reflex during abdominal surgery,[8] characterized by marked diminution of pulse pressure during mechanical stimulation of the celiac

plexus, administration of pitressin has been followed by a return of the arterial and pulse pressures to normal limits as exemplified in the following case report:
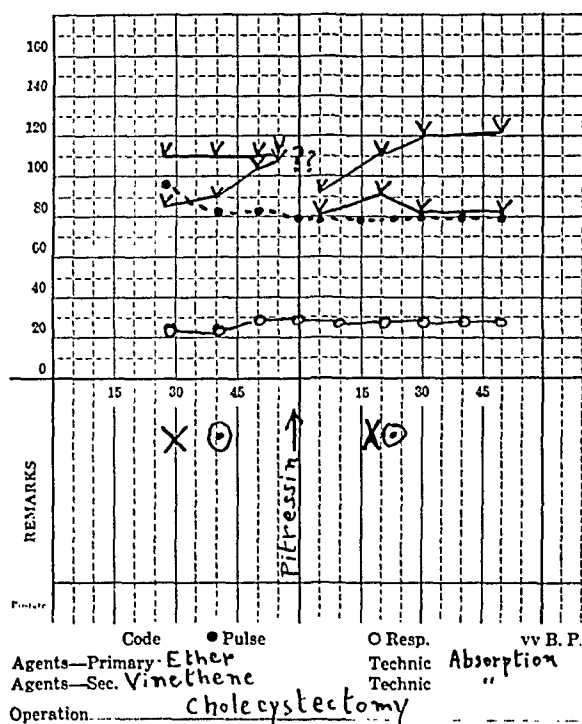
FIG. 2. Effect of pitressin on active celiac plexus reflex.

CASE III. (Fig. 2.) M. H., female aged 32 years, cholecystectomy indicated for cholecystolithiasis. She was a poor cardiac risk because of rheumatic heart with valvular lesion, functional capacity IIB, and auricular fibrillation. Anesthesia was induced with vinethene-ether sequence using the closed carbon dioxide absorption technic with excess oxygen. The arterial pressure at the onset was 110/85 mm. Hg; the pulse rate 96 beats per minute and irregular. Induction of anesthesia was uneventful and surgical intervention was begun in eight minutes. Ten minutes later, during abdominal exploration, the arterial pressure changed to 110/106, showing a rise in diastolic pressure while the pulse rate was 80 per minute and more regular than normally. Five minutes later the arterial pressure registered 110/108 (pulse pressure of two). Intervention progressed rapidly and was characterized by a minimum of bleeding. Five minutes later the facial pulse rate was still 80 per minute and the respiratory rate 24 with good volume exchange, but upon attempting to determine the arterial pressure no reading could be obtained during the next ten minutes. Pitressin, 20 units, was injected

intramuscularly. Six minutes later the arterial pressure could again be discerned at 90/80 and the improvement continued steadily during the next twenty-five minutes at which time the pressure had returned to 120/80 when the operation was completed.

The patient reacted twenty minutes after anesthesia was discontinued and recovery was uneventful.

3. EFFECTS OF PITRESSIN ON THE RESPIRATORY SYSTEM

Laryngospasm, bronchoconstriction and increased mucous secretion have occurred when pitressin was administered during anesthesia especially in asthmatic individuals. In several cases, asthmatic rales which had increased during cyclopropane anesthesia,[9] were relieved either by changing to ether or by injecting atropine, and recurred five to ten minutes following the intramuscular injection of pitressin. Likewise, pitressin administered postoperatively in asthmatic individuals was frequently succeeded by symptoms simulating an asthmatic attack.

CASE IV. R. W., a male, aged fifty-eight years, presented a recurrent inguinal herniorrhaphy. He was the typical barrel-chested, emphysamatous type giving a history of frequent attacks of asthma. Preoperatively some bronchial wheezes were audible. Anesthesia was induced with cyclopropane and surgery begun nine minutes later. It was then observed that the asthmatic rales and wheezes had greatly increased. Respiration became shallow and effortful on expiration and subcyanosis developed despite the high oxygen concentration in the breathing bag and despite a clear upper airway. This state persisted during fifteen minutes until ether was added to the anesthetic mixture whereupon the minute volume respiration increased, subcyanosis disappeared and pulmonary auscultation revealed clearing of the bronchial passages. This amelioration was maintained during the next forty minutes. Because the hernia involved a great intestinal mass it was deemed advisable to prevent postoperative intestinal atony by the administration of pitressin. Accordingly, 1 cc. of the drug was injected intramuscularly. Six minutes after the injection the bronchial

wheezes recurred, perspiration and lacrymation appeared, and respiration again changed in character, becoming difficult and prolonged on expiration. Operation ended a few minutes later and pitressin was ordered to be administered every four hours. Upon return to bed the patient's pulse rate was 86 beats per minute, the arterial pressure 130/70 mm. Hg, the respiratory rate 24 per minute but with prolonged expirations. Pitressin was again injected. Dyspnea then increased, perspiration became excessive and cyanosis became evident. Oxygen therapy by nasal oropharyngeal insufflation was started. Pitressin was administered regularly every four hours. Following each injection the pulse rate increased steadily until it reached 130 the following morning while the temperature rose to 101°F., and dyspnea continued. It was then suggested to cease pitressin therapy, and atropine 0.0006 Gm. (gr. $\frac{1}{100}$) was injected intramuscularly. Dyspnea decreased within a half hour and the pulse rate fell to normal limits within four hours. The next day pulse and temperature were normal. The patient looked good and recovery for the next two weeks was uneventful.

SUMMARY AND CONCLUSIONS

Observations of patients receiving pitressin therapy have revealed the frequency of varied systemic effects. Besides the beneficial effects for which the drug is indicated, certain detrimental reactions may also occur.

The beneficial effects observed have been: (1) intestinal contraction; (2) peritoneal relaxation during abdominal surgery; (3) rise in arterial pressure; which effect is prolonged by preliminary ephedrine administration; and (4) alleviation of celiac plexus reflex during abdominal surgery.

The detrimental reactions which may occur are: (1) fall in arterial pressure following a preliminary temporary rise; (2) cardiac irregularities; (3) coronary constriction; (4) increased mucous secretion and laryngospasm during anesthesia; and (5) bronchospasm, especially in asthmatic individuals.

Because of these varied effects it is suggested that the administration and dosage

of pitressin therapy be guided by individual reactions and susceptibility. The use of ephedrine to counteract circulatory depression following pitressin therapy is advised.

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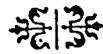
CASEATION is almost always a property of tubercle formation, but it is not regular in its quantitative phase or time or appearance. The size of tubercle, the type of parasite, and the nutrition of the host seem to influence its development considerably.

From—"Age Morphology of Primary Tubercles"—by Henry C. Sweany (Charles C. Thomas).

MULTIPLE FRACTURES OF THE SKULL COMPLICATED BY FRACTURES OF THE JAWS*

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MULTIPLE fractures of the skull complicated by fractures of the upper and lower jaws are of comparatively infrequent occurrence. Even large clinics report relatively few cases. When one searches the literature to obtain aid in the handling of these complicated cases, one is struck by the paucity of the reports and more so by the vagueness as to their management. For this reason the author believes that a detailed description of this case and its treatment will be a valuable contribution on this subject.

There were approximately 4,100 patients with fractures of the skull admitted to the Boston City Hospital in the twenty-five year period from 1915 to 1939 inclusive; 727 of these were female. The ages ranged from newborn infants to ninety-two years. All types of fractures were encountered, from the simple fracture without any intracranial involvement to the multiple compound type with severe brain complications. The sites of the fractures were either the vault or the base. Some were complicated by involvement of the nasal sinuses, mastoid, middle ear and jaws. There were 1,489 deaths resulting in a mortality rate of 36 per cent. If deaths occurring the first forty-eight hours are excluded, the mortality rate would probably be nearer 25 per cent. It must also be borne in mind that these were not selected cases but were admissions of severely injured patients, many in a dying or comatose condition. Further, they were treated on the general services of the hospital in contradistinction to those patients referred to the Neurological Service, the statistics of which appear elsewhere in this paper.

There were thirty-four cases complicated by fracture of the jaws, an incidence of 0.8 per cent. Twenty-eight of these were simple fractures, three were compound fractures and in three no mention was made in the record. In this series there were eight deaths, seven occurring within the first forty-eight hours of admission.

It is estimated[1] that in the United States 112,000 skulls are fractured annually with 28,000 deaths, a mortality of 25 per cent. The greatest mortality occurred within the first twenty-four hours.

The general mortality rate for Ramsdell's[1] series of one hundred consecutive cases was 23.0 per cent. Mock,[2] in a statistical study of 8,649 cases, showed a general mortality rate of 20.0 per cent.

The following table is a statistical analysis of cases of fracture of the skull with cranial injuries referred to the Neurological Department from the General Services of the hospital.

TABLE I
NONOPERABLE CASES

Ratio of Occurrence	Living	Dead	Total	Mortality Per Cent
63 0 nonoperable cases	652	106	758	13 9
0 9 concussion	11	0	11	0
18 2 edema and congestion	226	3	229	1 3
25 7 contusion	292	1⁻	309	5.5
43 0	·			19 8
1⁻ 3 laceration	123	86	209	41 1
Total series	953	250	1203	20 7

From the table above, it may be seen that the nonoperable cases comprise 63.0 per cent. Under the methods of treatment as carried out at the Boston City Hospital, the immediate mortality has remained about 14.0 per cent.

This is figured from all such cases without regard to the time of their death after

admission to the hospital. Since these figures are from admissions to specialized service (Neurological Service of the Boston City Hospital), from a general hospital they tend to be higher rather than lower as cited above.

It is impossible to standardize the treatment of all craniocerebral injuries, as each individual case presents its own requirements. The character of the pathology must, in the last analysis serve as a guide for the kind of treatment. The following is an outline of the nonoperative care which I employ in the great majority of cases. This is not to imply that operative indications in this group should be ignored.

TREATMENT

A summary of the non-operative treatment in craniocerebral injuries and as carried out in this case follows: (1) Rest in bed; (2) no morphine; (3) combat shock; (4) combat increased intracranial pressure by (a) magnesium sulphate, (b) hypertonic glucose solution intravenously, (c) lumbar drainage; (5) prevent dehydration; (6) prevent starvation; (7) local treatment, (a) scalp wounds, compound fractures, (b) discharge from ear and nose (sinuses), (c) other injuries; (1) fracture through the sinuses, (2) fracture of the jaws, etc.

·Dehydration methods are based on the fact that hypertonic solutions will withdraw fluids from the body tissues into the blood stream by a process of osmosis. In doing this, the brain is likewise depleted, thus lessening the increasing edema which has followed the cerebral injury. This method is considered new, yet old writers on skull fractures advocated rest and purging of the patient as the proper line of treatment.

Magnesium sulphate 4 ounces, 50 per cent solution is administered as retention enema and repeated every four to six hours during the first forty-eight hours. Glucose, 50 cc. 50 per cent solution or 100 cc. 25 per cent solution intravenously (sterile) may be repeated every eight or twelve hours. Glucose may be given during the shock

period. During the first forty-eight hours, fluid intake is restricted; after forty-eight hours fluids may be pushed.

The remaining cases are treated as follows:

Concussion. There being no signs or symptoms of cranial pathology, except total unconsciousness, after recovery is complete and all symptoms have disappeared, treatment other than rest in bed and supportive care is neither indicated nor required.

Edema and Congestion. Treatment is directed to shrinking of the brain by dehydration or the removal of the excess of backed-up cerebrospinal fluid by lumbar drainage. Dehydration may be carried out by intravenous injection of hypertonic glucose solution or magnesium sulphate by rectum. With lumbar puncture, enough cerebrospinal fluid is removed to reduce an abnormally high pressure to normal limits. This should be repeated every twenty-four hours until two successive normal pressure measurements have been obtained previous to withdrawal of any fluid.

Contusion and Laceration. Treatment is best carried out by a judicious combination of dehydration and lumbar drainage. Munro[3] states that dehydration alone is inefficient in these cases in exact ratio to the amount of free blood in the cerebrospinal fluid. This is due to the mechanical blockage of the arachnoidal villi by the free red blood cells. Operative decompression as a therapeutic measure is contraindicated.

Exploratory trephination, however, can be properly employed as a diagnostic measure whenever the patient fails to improve after a suitable interval of properly executed nonoperative treatment such as outlined above.

Cerebrospinal rhinorrhea may, however, prove to be very serious. It is not uncommon in frontal sinus fractures[5] and is due invariably to a fracture of the cribriform plate[4] in which a funnel-shaped fragment of the dura and arachnoid has been caught in the fracture line. Munro[4] believes fatal meningitis is a certainty unless the fistula

is closed. Packing, irrigation or blowing of the nose should be forbidden.

Fractures involving the frontal sinuses

to a nearby hospital on the morning of November 15 in a dazed and semiconscious condition and bled profusely from the mouth and nose.

FIG. 1. Photograph of x-ray film showing fractures involving the posterior wall of both frontal sinuses, the cribriform plate, the outer angle and the floor of the left orbit, the left malar, both maxillae and a fracture of the mandible at the symphisis.

only form a small percentage of our total cases.

Guardigian and Shawan,[5] in a series of 2,600 cases of skull fractures, found an incidence of 5.0 per cent of frontal sinus involvement. The majority of these were asymtomatic and recovered under conservative treatment. Where the posterior wall was involved with threatening intracranial complications operation is indicated.

CASE REPORT

A white male accountant, age thirty-one, while walking was struck by a moving automobile on November 14, 1937. He lost consciousness immediately and was not clear as to the details of the accident, but apparently he was unconscious for the greater part of the night of November 14 and 15. He was taken

On November 16, he was admitted to the Aural Service of the Boston City Hospital.

The examination was as follows: The patient was semiconscious and incoherent. T.P.R., 100.2°C. rectally, 84, 12 B.P. 136/62. The head is described below. The right pupil reacted sluggishly. Extraoccular movements appeared normal. The fundus of the right eye (which was the only one that could be examined), showed no choking. The ear drums were normal; the abdomen was soft; the bladder was enlarged somewhat; the inguinal region and genitalia were negative. Rectal examination showed a scar, presumably from an ischeorectal abscess, to the right of the anus. Prostate was normal. There was some feces in the rectum. The arms and legs showed the lacerations described below. Pulses were normal; reflexes were hyperactive and equal. There was left ankle clonus but no Babinski

or Hoffmann. Abdominal reflexes were not obtained.

The patient's past history was irrelative
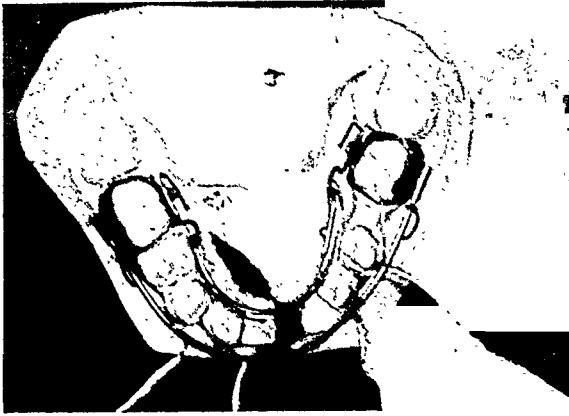
FIG. 2. Plaster model of lower jaw with orthodontia appliances in place. Note the teeth ligated to external arch wire and the expanding arch on the lingual surface.

except for an operation for an ischeorectal abscess a year before.

There was a ragged laceration of the chin and a through-and-through laceration of the lower lip. The lower teeth were loosened and the lower right central incisor was missing from an open socket which had a purulent discharge. There was a compound fracture of his lower jaw through the mucous membrane of the mouth and gums; the fracture line was just to the right of the midline. The entire jaw was markedly swollen, the upper and lower lips were lacerated, and there was considerable drooling of blood and saliva. The upper jaw was loose, displaced downward and both central incisors were fractured at their gingival margins. Occlusion was impossible. The tongue was markedly swollen. The patient was unable to swallow. There was induration and swelling in the right submaxillary region extending to the midline with areas of tenderness over the thyroid cartilages. The nose was swollen, bleeding and displaced toward the right with a depressed fracture of the nasal bones and the ascending process of the maxilla on the left side.

Anterior rhinoscopy showed marked congestion of the entire nasal mucosa; the septum was displaced toward the right side; the turbinates were engorged and soggy looking, there was considerable discharge of mucus, blood and cerebrospinal fluid. Posterior rhinoscopy was impossible because of the enormous swelling of tongue and downward displacement of the maxilla. The soft palate and uvula were mark-

edly edematous. There was laceration and abrasion over the upper eye lids with subconjunctival haemorrhage in both eyes. There was
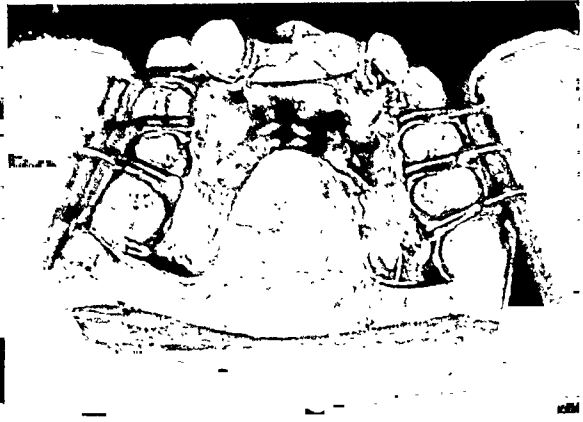
FIG. 3. Plaster model of upper jaw with cast metal plate and side arms in place.

considerable swelling at the outer edge of the left orbital border merging with the malar bone on that side.

X-ray examination revealed the following: Left stereo and A.P. of the skull showed multiple fractures: (1) through the posterior wall of both frontal sinuses; (2) through the cribriform plate; (3) through the outer angle of the left orbit; (4) through the floor of the orbit into the left antrum; (5) through both maxillae, more on the left with commutation of the wall of the antrum; (6) through the mandible in the right cuspid region. (Fig. 1.)

Diagnosis. Multiple fractures of the skull including fractures through the cribriform plate and posterior wall of both frontal sinuses with compound fracture of upper and lower jaw; concussion and edema of the brain.

Treatment of the Craniocerebral Injury. The nonoperative procedure was carried out. There was no intracranial pressure, since there was constant discharge of cerebrospinal fluid through the fractured cribriform plate and, therefore, treatment of this complication was not indicated.

Treatment of Lower Jaw. With intermaxillary elastics attached to orthodontia bands on the incisors, both halves of the lower jaw were kept in proper alignment. When the correct alignment was obtained, the orthodontia bands were converted to a retention appliance by uniting them with a soldered bar. The object of the appliances is to reduce the displacement of the fragments, to obtain correct alignment of the teeth and maintain the space of the missing central incisor. Without the

retention appliances there would very likely be contraction of the mandible at this point resulting in a V-shaped arch and hopelessly

Fig. 4. Plaster cap with att. clampers, a, plaster cap, b-b', hooks imbedded in plaster, c-c', elastics for upper jaw traction; b-b', wire arms in sleeves of upper plate, c-c', extension for fore and traction of lower jaw.

distorted normal occlusion. An external expanding orthodontia appliance[6] and an internal expanding appliance[7] were adjusted and ligated to the teeth of the lower jaw. (Fig. 2.) The Mershon arch was left in place for eight months to act as a retention appliance after union took place and after the Angle arch was removed.

Treatment of the Upper Jaw. A metal plate was constructed with side sleeves for the insertions of heavy wire arms. The plate was now placed into the mouth and the side arms, made of heavy coat hanger wire, were inserted into the sleeves of the plate. By means of heavy elastics the side arms were attached to hooks imbedded in a previously applied plaster cap around the head. The mandible, likewise, by means of heavy elastics was pulled upward and attached to a steel arm imbedded in the plaster cap. (Figs. 3 and 4.) With these appliances in place, and not withstanding the multiplicity of the fractures the patient was able to masticate semisolid foods at the end of four weeks. Through all this period, normal occlusion was maintained.

Complications. On November 26, 1937 an abscess in the submaxillary region was opened and drained. On December 1, 1937 an abscess in the submental region was likewise opened and drained. Irrigation of the left antra re-

sulted in a return of some fresh and old blood. No attempt was made to do any intra- or extranasal operations. It is noteworthy that

at no time did the patient complain of headaches. Since there was ample drainage of cerebrospinal fluid through the fractured cribriform plate, it is logical to assume that headache from increased intracranial pressure was thereby removed. Indeed, on only two occasions was any appreciable quantity of fluid obtained by lumbar puncture. This was on the third and fourth days after his admission to the hospital. Two other lumbar punctures done on the seventh and ninth days after admission yielded a small amount of clear fluid.

SUMMARY

1. A statistical analysis of 4,100 cases of fractures of the skull is submitted.

2. An outline of the nonoperative treatment of craniocerebral injuries is presented.

3. Report of a case of multiple fractures of the skull with cranial involvement complicated by compound fractures of the upper and lower jaw is given. The treatment of the jaw complications with orthodontia appliances is described in detail.

4. In spite of fracture through the cribriform plate and the posterior wall of both frontal sinuses with marked rhinorrhea and cerebral edema, the patient made a com-

plete recovery under conservative management as described.

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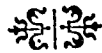
ONCE heart failure develops during pregnancy, the patient must be kept in hospital or under hospital conditions till delivered.
From—"The Heart in Pregnancy and the Childbearing Age"—by Burton E. Hamilton and K. Jefferson Thomson (Little, Brown and Co.).

HYPERTHYROIDISM IN ELDERLY PATIENTS*

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HYPERTHYROIDISM in elderly individuals is not an infrequent finding in a large group of patients with cardiac symptoms. The diagnosis is frequently missed because, first, the teaching has been that toxic goiter is a disease of the young and middle age, and second, symptoms of hyperthyroidism in the aged are often different from those found in the young.

The majority of patients over sixty years of age with hyperthyroidism have adenomatous goiters. Plummer has shown that adenomatous goiter is present from fifteen to seventeen years before toxicity develops unless provoked by the indiscriminate use of iodine.

In a study of eighty patients over sixty years of age with hyperthyroidism, the cardinal feature was that they were not stimulated to the degree that a like group of younger patients would be. This feature accounts for their less dramatic symptoms. It may be that the older patients have been overstimulated so long by the overactive thyroid that they have become less responsive.

The constant finding in the entire group was weight loss. It varied from a few pounds to practically half the normal weight. As a rule the weight loss extended over a period of one to four years. A normal or excessive appetite was noted in the activated group, whereas, in the nonactivated cases the appetite was often poor.

Cardiac complaints with palpitation and weakness on exertion were the next in order of frequency. Anginal symptoms were frequently noted. Most of the group had been treated for varying periods of time for heart trouble with practically no response to the treatment. Auricular fibrillation was a frequent finding. The heart sounds were loud and sharp and often there was a mitral systolic murmur present. The systolic blood pressure varied from 150 to 260 mm. of mercury. The diastolic pressure was not raised in proportion to the systolic pressure. The pulse pressure was markedly elevated in all cases. The pulse rate varied from 88 to 130. Most of the patients had taken digitalis over a long period of time with little response, particularly to auricular fibrillation when it was present. Some of the cases had cardiac decompensation and eight were not improved sufficiently by medical measures to attempt surgical relief. In the cases in which auricular fibrillation was not present, the use of digitalis did not prove to be of any assistance.

The patients in the activated group were sensitive to heat; their skin was warm and moist, and seldom was pigmentation noted; whereas, in the nonactivated group the skin was without tine, was dry and cold. Pigmentation was frequently noted in this latter group.

Among the patients with marked weight loss, gastrointestinal symptoms were observed with crises of vomiting and diarrhea. Many of the latter had been studied for gastrointestinal malignancy.

Eye findings were not constant. A few cases had exophthalmus (Fig. 1), but they were patients that gave a history of having developed exophthalmic goiter earlier in life and were what Hertzler[1] termed "burned out individuals." Stare was occasionally seen in the activated but not in the nonactivated group.

A psychosis is more frequently seen in the older group of cases and is often ascribed to senile dementia.

The entire group complained of muscle weakness and were easily fatigued. This

* Read before the American Association for the Study of Goiter, Rochester, Minnesota, April 15-17, 1940.

was out of proportion to their age and frequently led to the diagnosis of heart trouble. Digital tremor was seen but was not a constant finding.

FIG. 1. Apathetic hyperthyroidism. Low basal metabolic rate and auricular fibrillation present. Pulse 144, auricular fibrillation. Basal metabolic rate, +14. Many years' duration.

The basal metabolic rate as a rule was elevated but not to the degree found in younger individuals. Two years ago I reported a group of toxic cases[2] with basal metabolic rates within normal limits. Several of the cases included in that group are reported here. In the nonactivated or apathetic group as designated by Lahey,[3] the basal metabolic rates were around plus twenty.

There was a very definite goiter present in every patient. Some had rather large adenomatous goiters. In the cases that had taken iodine over a long period of time, the gland was hard and firm, often simulating a malignancy. Intrathoracic extensions were noted in a few cases.

Frequently cases are encountered that have progressed to such an extent and the

FIG. 2. Large cervical goiter, also large intrathoracic goiter. Pulse rate 120. Auricular fibrillation present. Basal metabolic rate, +22.

cardiac damage is so marked, that they can not be corrected surgically. Eight cases in this series were of this type. They did not respond sufficiently to medical measures to attempt pole ligation and all expired within a period of a few months.

The older group requires very meticulous preoperative care. Frequently they have other complications, such as old rheumatic hearts, generalized arteriosclerosis, impaired renal function and prostatic hypertrophy with retention, any of which add an additional burden to the hyperthyroidism. Most of the cases that had a diagnosis of hyperthyroidism made previously had taken iodine from a few months to several years. Such cases are iodine fast. If the iodine had not been administered, they could have been prepared much easier and with a larger margin of safety. It is often surprising how much can be done for those individuals with evidence of severe heart

disease when they are carefully prepared and are operated upon in stages. A high carbohydrate diet, Lugol's solution, digitalis if auricular fibrillation is present and diuretics in the presence of edema are given.

When the patient is first seen a preliminary evaluation of the risk should be made, because at no other time can this be done so advantageously. After the patient has been at rest with sedation and Lugol's, it is almost impossible to judge the proper time for operative interference without knowledge of the original status of the patient. In determining the status of a patient we have in addition to a complete physical examination with routine laboratory work, a stereo of the chest (Fig. 2), an electrocardiogram and blood chemistry determinations if there is any indication of renal impairment.

In particular we consider the pulse rate after bed rest of six to eight days, the length of time the disease has been present, whether iodine has been previously administered, and last, but not least, the weight loss and the rapidity of the same. Preoperatively we follow the preparation of the patient by the change of these factors and not by the lowering in the basal metabolic rate.

It is in older people that stage operations can be used most advantageously. If there is any doubt about the risk, one lobe is removed, the patient is permitted to recuperate at home six to eight weeks and then the other lobe is removed.

Local anesthesia, with light analgesia of gas, helium and oxygen, was used. These patients tolerate deep anesthesia very poorly. Furthermore, they do not tolerate large doses of barbiturates as such drugs produce too much depression. Codeine and small doses of morphia are used to relieve pain and restlessness.

Postoperatively the patient, if a poor risk, is placed in an ice cooled oxygen tent for two or three days. Five or 10 per cent glucose in normal saline solution is given slowly up to 2000 to 3000 cc. daily. This provides nourishment, stimulates renal

function, takes care of the water balance and prevents acidosis. These measures assist in preventing postoperative thyroid reactions.

Diligent postoperative care must be exercised to prevent pulmonary complications which often end fatally. If too much sedation is administered, the patient is depressed, mucus forms in the trachea, the patient is unable to cough it up and bronchopneumonia develops. Often the patient can readily expel the mucus by having him bend over the edge of the bed or by elevating the foot of the bed.

A study of seventy-two patients who were operated upon was made. These cases were divided roughly into the activated and nonactivated groups.

NONACTIVED OR APATHETIC GROUP
Number of Cases 22

Age	Length of Time Goiter was Present, Years	Blood Pressure	B.M.R., Per Cent	Weight Loss	Postoperative Mortality, Per Cent
Average 67 Oldest — Youngest 60	Average 22 Longest 42 Shortest 4	Average 170/90 Highest 240/170 Lowest 148/86	Average plus 28 Highest plus 42 Lowest minus 12	Average 34 pounds	2 or 9.9

ACTIVATED GROUP
Number of Cases 50

Age	Length of Time Goiter Was Present, Years	Blood Pressure	B.M.R., Per Cent	Weight Loss	Postoperative Mortality, Per Cent
Average 66	Average 18 Longest 28 Shortest 3	Average 180/92 Highest 230/130	Average plus 32 Highest plus 52 Lowest minus 8	Average 26 pounds	2 or 4

The operative mortality in the group of patients over sixty years of age was 5.5 per cent. In a large group of cases under sixty years of age the operative mortality was 1.2 per cent.

The following case reports illustrate our management for goiter patients of this age group:

CASE REPORTS

Case i. Mrs. E. W. H., age sixty-eight years, housewife, (Fig. 3), complained of

caloric diet and bed rest. After two weeks her pulse rate was 96 and regular, the basal metabolic rate was plus thirty-six, and there had
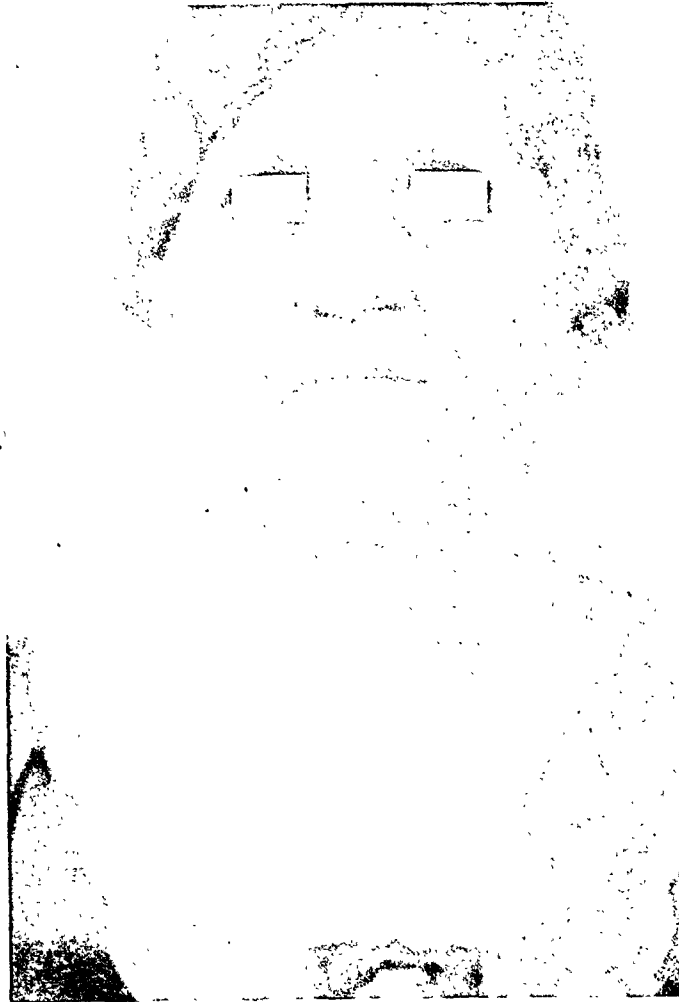
Fig. 3. Goiter present thirty-five years. Pulse rate 138; auricular fibrillation present; basal metabolic rate, +52.

weight loss, palpitation, weakness, choking attacks and nervousness of three years' duration. She stated that a goiter had been present for thirty-five years. She first noticed gradual loss of weight and had attacks of indigestion accompanied by vomiting and diarrhea. She had been treated for colitis, heart trouble and high blood pressure. Examination revealed a markedly emaciated woman, weight one hundred three pounds (normal weight one hundred and sixty-eight), skin moist and warm, pulse rate 138; the heart was fibrillating; blood pressure 240/130 mm. of mercury. There was digital tremor and eye stare present. Her basal metabolic rate was plus fifty-two. Both lobes of the thyroid were nodular and firm. There were no pulsations or bruits. She was hospitalized, put on Lugol's solution, digitalis, high

been a gain of six pounds. A bilateral thyroidectomy was done. The patient went into a coma after a few hours and remained stuperous for four days, during which time she was given 3,000 cc. of 5 per cent glucose saline intravenously daily and two transfusions of 400 cc. of whole blood. The pulse rate did not exceed 130. She gradually improved and was dismissed from the hospital on the sixteenth day. One year later the basal metabolic rate was plus six, pulse rate 78, and blood pressure 190/120. She expired in 1938 from apoplexy at the age of seventy-seven, nine years after the operation. This patient would have done better with a two-stage operation.

Case ii. Mrs. T. E. E., age sixty-six, housewife, was referred by Dr. E. E. Davis, of Albuquerque, New Mexico. The patient stated

she was referred to Dr. Davis from Indiana for tubercular treatment. She complained of coughing, choking, loss of weight and strength. She was very nervous but had an excellent appetite. Examination: poorly nourished white woman, weight ninety-six pounds (normal weight one hundred and forty pounds), skin moist and warm, digital tremor, lid lag and stare. The right lobe of thyroid was markedly enlarged, nodular and firm. The left lobe was substernal, producing tracheal deviation. The pulse rate was 110, and the heart was fibrillating. Her basal metabolic rate was plus thirty-four. The patient was hospitalized, given a high carbohydrate diet, Lugol's solution and digitalis. After twelve days her pulse rate was 102 and her basal metabolic rate plus thirty-two. A right lobectomy was done. Convalescence was uneventful and she was sent home. After eight weeks she returned. She had improved considerably and had gained six pounds in weight, but still complained of choking. Her pulse rate was 100. The auricular fibrillation had disappeared. The intrathoracic left lobe was removed. No follow-up report was obtainable.

CASE III. Mrs. J. E. F., age sixty-nine, housewife, was referred by Dr. W. P. Martin, of Clovis, New Mexico. The patient stated she had smothering attacks, marked loss of strength and weight, poor appetite and attacks of diarrhea and vomiting. Examination revealed an elderly woman with evidence of marked weight loss. Her skin was cool and dry. No digital tremor or ocular signs were present. The thyroid was three or four times the normal size and both lobes were very firm. The pulse rate was 96 and regular. Blood pressure was 160 systolic and 80 diastolic. Moist rales were found over the bases of both lungs, and there was one plus edema of the ankles. The urine showed a two plus albumen, and there were coarse and fine granular casts. Her basal metabolic rate was plus six. The patient was hospitalized, given Lugol's solution, a high carbohydrate diet, and two weeks later a right hemithyroidectomy was done. She was given an immediate blood transfusion, put under an ice cooled oxygen tent, and given 3,000 cc. of 5 per cent glucose saline solution daily by slow drip. She gradually became unconscious. Her pulse rate remained under 100 and was regular. At the end of four days she began to improve and was dismissed on the sixteenth postopera-

tive day and permitted to go to her home. After two months she returned feeling much better and a left hemithyroidectomy was done. She was placed immediately under the ice cooled oxygen tent and given 400 cc. of citrated blood. Her convalescence was without incident. When seen five years later she had regained her former weight and was able to do her own house work. She had lost her apathetic appearance and was again interested in outside activities.

CASE IV. A male, age sixty-two, was referred by Dr. H. A. Ingalls, of Roswell, New Mexico. He complained of pain on exertion, shortness of breath, and loss of thirty pounds in weight. He had been treated for angina for the preceding three years. Exertion produced a substernal pain which radiated to the left shoulder and left arm. At first nitroglycerin would give relief. Examination revealed a well nourished man, weight one hundred sixty-two pounds (former weight one hundred ninety-four pounds), skin moist and warm, slight stare and lid lag. Both lobes of the thyroid were markedly enlarged and firm. His pulse rate was 118 and irregular. Blood pressure 180 systolic and 100 diastolic. His basal metabolic rate was plus forty-one. After two weeks rest in bed, a high carbohydrate diet, Lugol's solution and digitalis, his pulse rate was 98 and regular. A right hemithyroidectomy was done. He made an uneventful convalescence and was discharged on the tenth postoperative day. He was requested to return after six weeks for the second lobectomy, but he was not seen again for two and one-half years. When he returned he stated he had felt so well after the first procedure that he did not think any further treatment was necessary. However, lately his former symptoms have returned. Examination revealed his pulse rate to be 106 and regular. His basal metabolic rate was plus twenty-four. He was given preoperative treatment as before, except for digitalis. A left hemithyroidectomy was done. He had marked anginal pain for ten days, then it disappeared. He was discharged on the fourteenth postoperative day and has since resumed his former position. For the past three years he has had no anginal attacks.

CONCLUSION

The diagnosis and management of hyperthyroidism in the younger individual is often difficult. In the aged ones diagnostic

acumen is even more taxed, and only by attention to many details can the elderly patient be carried safely through operation. However, the end results are highly satisfactory and years of life are added. The medical profession, particularly the general practitioner, must be made more aware of the fact that hyperthyroidism can exist in elderly patients and be taught to recognize it as such, for he is the person who usually sees these cases in the beginning. The medical profession in general must become more acquainted with the excellent operative results that can be obtained in a large percentage of these patients.

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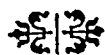
In early tubercle formation, . . . the appearance of the gray center of the tubercle is simultaneous with the appearance of allergy. There may be more than allergy, however, because other allergic reactions may not caseate at all.

From—"Age Morphology of Primary Tubercles"—by Henry C. Sweany (Charles C. Thomas).

A REVIEW OF 500 GYNECOLOGICAL PATIENTS WITH URINARY SYMPTOMS*

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THE proximity of the generative and urinary tracts in the female, and the frequency of associated pathology often results in errors in diagnosis and treatment.[1,2] Gynecological conditions frequently present themselves as urological problems, and residual disease in the urinary tract often requires treatment after the gynecological pathology has been eliminated.

At Harlem Hospital a cystoscopic clinic was organized on the gynecological service to study this large group of patients. In about 90 per cent of these cases the pathology was found to be limited to the vesico-urethral junction, which includes the internal sphincter and bladder neck, with extension often, above to the trigone, and below to the urethra.

For purposes of cystoscopic orientation, diagnosis, and therapy, the urinary tract was divided into the following parts: urethra, internal sphincter, bladder neck, and trigone.

Urethra. The female urethra is short and bathed with fecal and leucorrheal discharge and it is, therefore, not surprising that urethral inflammation occurs frequently.[3,4,5]

Actual strictures of the urethra are uncommon, but the lumen is often diminished, necessitating dilatation before a cystoscope can be introduced. Stevens calibrated the urethra of 118 women who had no symptoms, and found the average size to be F26, the smallest F18, and the largest F30. A urethra below F26 is often responsible for symptoms and pathology. Of a total of 1,227 patients with urinary symptoms, Stevens found narrowing of the urethra in 458, or 37 per cent. Early detection and correction of stricture or constriction of the female urethra is important.

Internal Sphincter. Edema or contraction of the internal sphincter, the dividing line between the urethra and bladder neck, is also a common lesion. The mucosa of the internal sphincter is pushed into the lumen of the urethra, projecting around the circumference. When uneven, it appears scalloped, or in the form of well defined polypoid masses or papillary folds which move in the irrigating fluid.

Bar formation, or the raising of the posterior margin of the internal sphincter, is a lesion that has long been underestimated in the female. It appears in the lower cystoscopic field as a barrier which often obstructs the view of the bladder. When the tip of the cystoscope rides over the bar and is depressed, a view of the trigone may be obtained. This condition was first recognized by Mercier, who called it "valvules du col de la vessie."[6] The pathology consists of a dense submucosal fibrosis and sclerosis, which results from previous inflammatory edema.

Bladder Neck. The bladder neck which lies just proximal to the internal sphincter at the apex of the trigone, may be the site of hyperemia, simple or bullous edema, or pseudomembranous exudate. These may be associated with similar conditions of the trigone and internal sphincter. Hyperemia is characterized by an intense uniform redness of the area. Bullous edema consists of groups of pinhead or larger sized whitish or greyish translucent areas. In pseudomembranous edema, a whitish membrane covers the vesical neck and may ex-

tend over the trigone, with irregular, peninsular-like projections and sharply defined borders.

Trigone. Normally, the surface of the trigone is covered with a fine network of vessels, as compared to the pale yellowish appearance of the surrounding bladder mucosa. This vascularity is often mistakenly considered pathological. Only when there is a marked increase in the number and size of the vessels, approaching a hyperemia, or, if they are obscured by edema, or membranous exudate, should a diagnosis of trigonitis be made. Recently, attention has been called to trichomonas as a possible cause of trigonitis.[7]

ETIOLOGY

There is unquestionably a definite relationship between pelvic infection and disease of the vesico-urethral junction. The close anatomical relationship between the base of the bladder and the anterior surface of the cervix up to the level of the internal os, allows direct extension of an infection from the cervix. Winsbury-White injected India ink into the cervices of guinea pigs, and found the particles traveled directly beneath the trigone and bladder via the lymphatics.[8]

Circulatory, neurological and psychic factors also play a role.[9] Congestion of the pelvic organs, due to menstrual disorders, coitus interruptus, etc., produce trigonitis because of the intimate relationship between the venous, lymphatic and nerve plexuses of the two tracts.

Psychic factors such as marital maladjustment, fear of pregnancy, and the menopause play an important rôle in the genesis of urinary symptoms. Deliveries are of importance in the production of bladder symptoms because of destructive injuries to the supporting structures and sphincteric muscles. Low grade infections of lacerated cervices also result, which may be transmitted to the trigone.

Surgical trauma should also be considered, as it is quite likely that mobilization of the bladder from above or below

may occasionally interfere with its innervation and vascular supply and produce local symptoms.[10,11]

SYMPTOMATOLOGY

Identical symptoms are often produced by lesions located at any point between the extreme levels of the urinary tract. Frequency, nocturia, burning, urgency and incontinence, or a combination of any of these, are the common symptoms. Nocturia is an important index of the intensity of the symptoms, whereas diurnal frequency is often a manifestation of general nervousness.[12] Usually no gross pathology is found to account for the symptoms except changes in the vesico-urethral junction often missed in the search for diseases of the kidneys, ureters or bladder.[13]

In the history, incontinence and urgency must be differentiated. In the former there is involuntary passage of urine and, in the latter, the desire to urinate must be immediately satisfied.

Hematuria is not a common symptom and is usually due to gross urological lesions.

Referred pain in the lower back is rather common. This may be due to trigonitis, but is primarily caused by the associated pelvic pathology.

DIFFERENTIAL DIAGNOSIS

Most cases of irritable bladder neck and urethral inflammation in the female are diagnosed as "cystitis." This blanket diagnosis of cystitis has been assiduously avoided here. The diagnosis of cystitis should be sharply limited to those cases in which the inflammatory process extends beyond the trigone to the bladder walls.[14] In cystitis, the urine usually contains pus, which calls attention to complaints of these patients, resulting in early urological study.[15] Disturbances in the urethra and bladder neck may cause marked urinary symptoms in the presence of a negative urine.[16] Therefore, a negative urine should not preclude careful cystoscopic examination with particular attention to this

area. Concentration on the inflammatory changes found here should not, however, lead to the neglect of other gross urological lesions which may co-exist. In this series less than 10 per cent had complicating gross urological lesions.

TREATMENT

If one is able to classify the urological symptoms occurring in the female and correlate them with the anatomical, pathological and cystoscopic findings, a standardization of treatment based on the pathological and cystoscopic findings becomes possible. Bladder irrigation and instillation therapy is the usual treatment given to most female patients with urinary symptoms. When relief is not obtained after long periods of such treatment, these patients are often unfortunately classed as neurotics. The various changes that occur in the vesico-urethral junction have a similar etiology, produce largely the same symptoms and often respond to the same therapeutic measures. This is often confirmed clinically when appropriate treatment of the cervix causes disappearance of urological symptoms. Similarly, eradication of other pelvic inflammation produces relief of urinary symptoms.

All patients are instructed to take hot douches and hot sitz baths daily, as the heat and hydrotherapy helps alleviate urinary distress and reduces pelvic inflammation. Frequently, this alone, or with the administration of simple sedatives (bromides, luminal, etc., or tincture of hyocyamus) relieves the symptoms, particularly in mild congestion of the trigone or bladder neck, caused by pelvic inflammation.

Relief of mental tension with sedatives may relieve urinary symptoms which are often present, despite the absence of any local pathology. This is particularly true in menopausal cases in which the addition of estrogenic hormone also improves the local atrophy.

In the treatment of hyperemia of the trigone, correction of the pelvic disease may, in itself, eliminate all symptoms.[17] If the usual hydrotherapy is not sufficient, Kelly treatment may be instituted. This consists of the topical application of 1 to 5 per cent silver nitrate, through an endoscope, with the patient in the knee chest position and the bladder empty. Where there is associated edema of the bladder neck, Kelly treatments may be used but should be accompanied by dilatation.

In cases of diminished capacity of the bladder, due to a chronic cystitis or to extravesical pressure, hydraulic distention of the bladder is of value.

When a cystitis is also present, e.g., the inflammatory process has extended beyond the trigone or base of the bladder, bladder irrigations of boric acid, acriflavine or other antiseptics are given, followed by instillation of argyrol, 10 per cent.

When a diminished caliber of the urethra, or disease of the internal sphincter and bladder neck is found, introduction of various sized Hegar or Hank's dilators, past the internal sphincter is specific. Treatments should be given weekly, gradually increasing the caliber of the dilators until a 10 or 11 Hegar or 28F or 30F French sound is reached. Usually, no more than six to nine treatments are necessary with the largest sized dilators. Gentle massage over the sound with the finger in the vagina has been found of value. Often the symptoms subside following the first treatment, which may explain the cessation of symptoms that often follows a simple cystoscopy. Since involvement of the urethra and bladder neck were found so commonly, dilatation of the urethra was almost always necessary.

In cases of actual urethral stricture, when the caliber is so small as to barely admit a No. 4 ureteral catheter, bougies can be used, until the caliber of the urethra permits the passage of sounds. When bar formation is found, dilatation almost always gives prompt relief as this edematous area recedes with dilatation. Occasionally it may be necessary to employ the high frequency current to cut through the bar

or to destroy polypoid formations of the internal sphincter, but in either case, dilatation should follow.

A detailed analysis of 500 consecutive cases with urinary symptoms from the cystoscopic clinic of Harlem Hospital, and from the wards of the gynecological service, from which the above conclusions were reached, is presented.

Age:
    Average age: 35.6 years
    20 to 40 years: 300 or 58 per cent
    40 or over: 176 or 13 per cent
    Menopause: 108 or 31 per cent
    a, surgical: 41 or 18 per cent
    b, spontaneous: 67 or 13 per cent
    c, Marital status:
      Married: 410 or 82 per cent

A large number, 175 or 35 per cent, complained of being nervous and irritable, due, among other causes, to marital maladjustment and fear of pregnancy.

Gravidity:
    Gravid: 385 or 77 per cent
    Parous: 315 or 63 per cent
    Endocervicitis: 170 or 34 per cent

The importance of gravidity with its consequent trauma including endocervicitis, in the production of bladder symptoms, has been emphasized. The occurrence of cystocele, urethrocele and prolapse, was remarkably rare in this series. The great majority of the patients treated in this hospital are colored. The fascia and musculature of the female negro are very strong and elastic which explains the rare necessity of pelvic repair for prolapse or incontinence.

Surgical History. Gynecological operations: 90 or 18 per cent (usually for fibroids, pyosalpinx, or tubo-ovarian abscess). There were no unusual changes in the bladders of these patients, as is sometimes found after mobilization of the bladder in plastic repair. There was a history of the latter in only three cases, in which the pathology found, bore no relation to the surgical procedure.

Symptomatology:

	No.	Per Cent
Frequency	360	72
Burning urination	190	38
Urgency	225	49
Incontinence	95	19
Hematuria	35	7
Backache	225	51

Duration of symptoms:

	No.	Per Cent
2 weeks to 6 months	230	46
6 months to 1 year	100	20
1 year to 5 years	115	23
Over 5 years	55	11

Of considerable significance is the fact that 170 or 34 per cent had symptoms for more than a year before proper urological investigation was done.

Although the following table gives the frequency and the type of pathology found, there is considerable overlapping, as many cases had a combination of several types.

CYSTOSCOPIC FINDINGS IN 467 PATIENTS

	No.	Per Cent
Vesicourethral junction, urethra and trigone:		
Edema of bladder neck	345	74
Edema of internal sphincter	280	60
Bar formation	70	15
Polypoid or villus formations	57	12.2
Relative stricture of urethra	84	18
Hyperemia of trigone	205	44
Edema of trigone	53	11.3
Acute cystitis	22	4.7
Caruncle	7	1.5

The following cases though not discussed were associated with gynecological pathology.

	No.	Per Cent
Vesicovaginal fistula	3	.7

Ureteral obstruction with dilatation of the ureters and calyces:

	No.	Per Cent
By fibroids	18	4
By adnexal masses	12	2.9
By parametritis	5	1.0
Rupture of pyosalpinx into bladder	2	.43
Laceration of bladder in hysterectomy	1	.2

	No.	Per Cent
Primary gross urological disease:		
Nephroptosis	6	1 3
Carcinoma of bladder	2	.43
Hypernephroma	1	2
Polycystic kidneys	3	7
T.B. Kidneys	2	.43
Calculi of bladder	1	2
Pyonephrosis	1	2
Ureteral calculi	2	.43
Pyelonephritis	2	.43

Of the 467 cystoscopies, only 23 or 4.9 per cent revealed primary major urological lesions. If urethral caruncle and acute cystitis were included, the total is 54 or 11.17 per cent.

Treatment: Other than the unusual and major urological cases requiring special treatment, the remainder, 428 patients were treated as follows:

	No.	Per Cent
Dilatation of the urethra	312	73
Bladder irrigation with instillation of argyrol (acute cystitis)	22	5
Hot sitz baths and douches only	94	22

Results of Treatment: Of the 428 cases treated by methods above, results are unknown in 64, leaving 364 cases.

	No.	Per Cent
Improved	214	59
Cured	117	32
Not improved	33	9

No patient was pronounced cured until there was complete cessation of urinary symptoms. A patient was classified as improved when there was a definite diminution of the major urinary symptoms.

SUMMARY AND CONCLUSIONS

1. Urinary symptoms in the great majority of female patients have their origin in the vesico-urethral junction.

2. The female patient with urinary symptoms should have a meticulous examination of the urethra, bladder neck and bladder.

3. The correction of gynecological disease and abnormal physiological changes is frequently followed by alleviation of the urological symptoms.

4. The patient's history particularly regarding menopause, marital status, mental health, age and other factors are important in the consideration of treatment.

5. Dilatation of the urethra is of definite value in the treatment of diseases of the vesico-urethral junction.

6. Hydrotherapy, general hygienic measures and proper sedation should accompany local treatment.

7. The term, "cystitis," so frequently used as a diagnosis to cover urinary symptoms, should be replaced by that applicable to the specific pathology found.

8. The gynecologist should have proper training in cystoscopy and also endoscopy of the urethra.

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STUDIES IN URINARY ANTISEPSIS*

CLINICAL INVESTIGATION OF MANDELAMINE, A RECENTLY INTRODUCED URINARY ANTISEPTIC

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THE search for the perfect urinary antiseptic has been a long one. Twenty years ago, Davis described the ideal as a bactericide for internal use which would be chemically stable, nontoxic in therapeutic doses, would not irritate the urinary tract mucosa, would be bactericidal in high dilution of urine of any reaction and capable of being excreted practically unchanged in full amount by the kidneys. But he added sadly, "There is no such drug known."

However, during the two decades which have elapsed since this pessimistic utterance, considerable progress has been made. The ketogenic diet was first instituted in 1917, but it was not until 1931 that its use to render sterile the urine of urologic patients was made practical by Helmholz and others. But after exceptionally wide clinical trial it was realized that the usefulness of the method was definitely limited. In many cases of severe prostatitis, even when the diet reduced the ordinary pH of the urine to a satisfactory level, and the beta-oxybutric acid was adequately concentrated, the organisms in the urine were not eliminated. It was evident that a change in the reaction of the urine was not the only factor necessary to inhibit bacterial development.

Because of his dissatisfaction with the results obtained by use of the ketogenic diet, Rosenheim began using mandelic acid —a dosage of 12 Gm. daily, combined with 8 Gm. of ammonium chloride and a fluid intake of one quart (32 ounces). This dosage usually kept the pH of the urine below 5.5 and was to that extent very satisfactory. But so many patients were unable to tolerate the drug that the same objections urged against the employment of methanamine and the ketogenic diet were again brought to bear to discourage the use of mandelic acid as a urinary antiseptic.

It had several times occurred to the present writer and, as later appeared, to many other workers in the field of urinary pathology, that if methenamine and mandelic acid might be combined, the advantages presented by each might be retained and their drawbacks eliminated. In 1938 and 1939, workers at the University of Minnesota and elsewhere, demonstrated that such a combination was chemically possible, and showed that the combination was bactericidal in varying concentrations at different pH levels. Even before this, Tisza had attained a similar chemical combination, and had shown *in vitro* that methenamine mandelate in sufficient concentration is effective against staphylococcus, streptococcus and the colon bacillus. When enthusiasm over the use of sulfanilamide was rapidly increasing, the importance of this work was not fully realized; but with the discovery that indiscriminate use of the sulfonamides was fraught with many dangers, attention was once more focused on improvement in already existing agents.

The chemical combination of mandelic acid and methanamine is methenamine mandelate whose structural formula is shown in Figure 1. Methenamine mandelate is very soluble in water, alcohol, acetone, chloroform and in hot benzene, less so in cold benzene solution, but is

insoluble in ligroine. The melting point of methenamine mandelate is 128° to 130°C. It is a new chemical entity and an analysis of
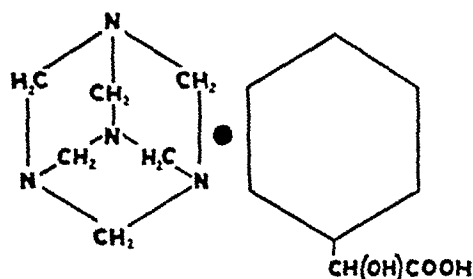
Fig. 1. Methenamine mandelate, mandelamine.

the clinical results shows that it cannot be regarded as just another mixture of mandelic acid.

In the author's service at City Hospital, Welfare Island (New York City) adequate urinary antisepsis is an ever present clinical problem. When it was brought to our attention that a chemical combination of mandelic acid and methenamine was available,* it was decided to give it an extensive clinical trial, as it was in line with views long held by the author. Complete studies on sixty-three cases are now available for report; a much larger number cannot be included because, owing to the shifting character of our clientele, it is frequently impossible to follow up the individuals long enough to permit drawing adequate conclusions.

The different conditions under treatment are shown graphically in Table 1. It will be seen that simple cystitis was of most frequent occurrence, with the bladder inflammation accompanying prostatic hypertrophy furnishing the next greatest number of cases. The prevailing organisms were Bacillus coli, streptococcus and staphylococcus. The average dosage was three tablets three times daily, each tablet containing 0.25 Gm. methenamine mandelate. The total daily dosage is therefore 2.25 Gm. methenamine mandelate, mandelamine, of which 1.18 Gm. are mandelic acid and 1.0⁻

* Methenamine Mandelate, Mandelamine, used in this study was supplied through the courtesy of Nepera Chemical Co., Inc., Yonkers, N. Y.

Gm. are methenamine by analysis. A few patients received as much as three tablets, four times daily, but even with this dosage – the maximum—no toxic manifestations were in evidence. At no time did any patient suffer the nausea, vomiting, or other gastrointestinal disturbances which had occurred so frequently in the past when other urinary antiseptics were being employed.

TABLE 1

Cystitis	18
Pyelitis	10
Cystitis with prostatic hypertrophy	14
Pyelitis with prostatic hypertrophy	5
Pyelonephritis	8
Pyelonephritis with stone	1
Urethral calculus with cystitis	1
Urethral fistual with cystitis	1
Kidney stone with pyelitis	1
Hydronephrosis with cystitis	1
Carcinoma of the prostate with cystitis	2
Suprapubic cystotomy with cystitis	1

Laboratory routine studies:
  (a) Culture of urine every second day
  (b) Determination of urinary pH on each specimen
  (c) Microscopic examination of urine specimen daily

Results. Of the sixty-three patients whose cases are here discussed, fifty-four or 83 per cent showed definite improvement under the medication. In twenty-four cases the urine cleared, with negative cultures for Bacillus coli, Staphylococcus albus, and nonhemolytic streptococcus (the various organisms previously demonstrated) within three to five days. In twenty-eight cases the urine cleared and the cultures became negative after more extended trial. In four patients the improvement was questionable, and in four cases the medication was quite without effect. Two of these last mentioned patients died of intercurrent disease while the treatment was in progress.

Some of the more noteworthy histories may be very briefly summarized:

CASE REPORTS

CASE 1. M. D., a male, had prostatic hypertrophy, pyelitis and cystitis. His chief complaint was frequency and burning. The duration of symptoms was four months. The

culture obtained was streptococcus, Bacillus coli and mixed bac. Mandelamine dosage consisted of three tablets, three times daily. The third culture showed no growth; frequency and pain disappeared, and the nocturia was greatly improved after the fourth day of medication. He was on regular diet throughout, with absolutely no gastrointestinal disturbance.

CASE II. F. L., a male, forty years old, had cardiac decompensation, and prostatic hypertrophy of six years' duration. His chief complaint was difficulty of urination. Under regular dosage of mandelamine the urine cleared on the third day, the previous foul odor disappeared and there was less frequency. There were no toxic symptoms of any description.

CASE III. A woman of 80 years, had a fractured right femur, pyelitis and cystitis. Her chief complaint was urgency. At the first examination the urine was negative, but on the fifth day after the accident, Bacillus coli appeared. Under regular dosage of mandelamine, the urine cleared on the third day after medication started, and the general condition was much improved by the fourth day. There was no toxic reaction at any time.

CASE IV. C. S., a male, aged seventy-nine years, had cancer of the prostate with associated cystitis and much pus in the urine. His chief complaint was frequency. Under regular mandelamine administration the general condition improved and there was clearing of the urine by the fourth day of medication, the reaction was negative on the sixth day and pain was greatly lessened. In this inoperable condition in an aged patient, the greatest benefit was derived from our ability to control the urinary infection.

CASE V. L. J., a male, aged fifty-one years, entered the hospital because of acute retention, giving a history of urinary difficulties extending over some ten years. Examination revealed a tight stricture of the urethra as the cause of retention. The urine was loaded with pus and culture revealed Streptococcus and Bacillus coli. In connection with urethral dilatation, mandelamine administration in regular dosage was instituted. The urine cleared in four days, but Bacillus coli continued to be demonstrated until the twenty-third day, following a second dilatation. Throughout the long course of medication required by this peculiarly obstinate infection mandelamine was perfectly tolerated, producing no toxic manifestations of any kind.

CONCLUSIONS

In the combination of mandelic acid and methenamine, such as is presented in mandelamine, methenamine mandelate, a new urinary antiseptic to which clinical trial has been given in the author's service at City Hospital, Welfare Island, New York, we now have an efficient and reliable urinary antiseptic which bids fair to fill a want long acutely felt in urologic practice. The results attained in sixty-three cases upon which full data were available, conclusively show that with this medication no toxic effects are manifested, and that the patient may remain on regular diet throughout the entire period of administration, provided he has no physical condition which would forbid it. In obstinate cases in which the medication must be long continued, this combination has proved especially valuable, as it produces none of the toxic effects which limited the usefulness of the older drugs from which it is derived, no matter how long its use is continued.

SUMMARY

Although mandelic acid and methenamine have both been used extensively as urinary antiseptics, their toxic effects, particularly in long continued administration, have seriously limited their employment.

The chemical combination of these two drugs having been found practical, the author made use of mandelamine, a recently introduced form, in the treatment of patients seen in the urological service at the City Hospital, Welfare Island, New York.

In sixty-three cases in which full data were available, excellent results were obtained. An average dosage of three 0.25 Gm. tablets, three times daily, readily controlled most of the common urinary infections, maintaining a urinary acidity below 6.0 without the use of any accessory acid administration. In the majority of the patients the urine cleared within three to five days, and such symptoms as frequency

and urgency were reduced or entirely eliminated.

None of the patients at any time manifested toxic symptoms. This demonstrates that the effectiveness of methenamine as a urinary antiseptic has not been impaired by its chemical combination with mandelic acid, although the nausea, vomiting and other gastrointestinal disturbances induced by high dosage of mandelic acid have been eliminated.

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. . . the usefulness of ordinary roentgenology is decidedly restricted in dealing with vascular diseases. In order to obtain more information in reference to the efficiency of the circulation and anomalous structures, visualization of the arterial tree is necessary.

From—"Peripheral Vascular Diseases"—by Kramer (Blakiston).

THE SIGNIFICANCE OF BLEEDING PER RECTUM

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THE rectum and colon have long been the happy hunting ground of quacks and charlatans. Magazines and newspapers can be found in all sections of the country in whose columns are advertisements for "Pile Cures," "Rectal Massagers," "Colonic Lavage Treatments," "Electro-Tonic Method," "Dilators" and "Rectal Clinics," all of which contain the highest self-praise imaginable for the particular nostrum or "clinic" which is being touted. It seems incredible that many of our citizens can be made to accept the trash that is handed out to them in such brazen fashion and in such copious amount. I have recently discussed quacks and charlatans more fully in an article which appeared in the March issue, 1941, of *Hygeia* under the title, "The Sure-Cure Racket."

Modesty is a questionable virtue when one has bleeding from the rectum. Curiously enough, a patient who would not hesitate to see an ethical physician when stricken with pneumonia, will slink up the back stair of the local hotel to be injected for hemorrhoids by a travelling quack or self-styled "professor of rectal diseases." I saw one such patient a short time ago. She was a gentle, elderly schoolteacher who gave us the same story which many physicians are hearing daily everywhere. She had noticed blood in her stool for several months and having seen the blurb in the local paper about the forthcoming visit from a "pile-doctor," she went to see him. He injected her "hemorrhoids," and two months later she visited an old friend who was a doctor's wife. The bleeding still continued. Fortunately, she told the friend the whole story and a carcinoma, involving the posterior wall of the rectum with slight fixation, was found and removed. The loss of two months' time, however, may make a great difference in the prognosis.

In another similar case, a rural letter carrier in a Central state noticed slight diarrhea of two months' duration. He saw the advertisement of a well-known quack and instead of going to a reputable hospital within a few miles of his home, he fell into the clutches of the charlatans. He was told that for $140.00 in advance a cure would be guaranteed. The diagnosis was "colitis." After submitting to "colonic lavages" every day for two weeks he left, five pounds lighter in weight and $140.00 lighter in pocket. We saw him nine weeks later and found an advanced carcinoma of the rectosigmoid, of which he died very shortly thereafter. A colostomy was done as a palliative measure.

It is true, of course, that the commonest cause of bleeding from the rectum is from hemorrhoids. In fact, in my experience, 20 per cent of all people examined proctosigmoidoscopically will be found to have hemorrhoids to a greater or less degree. However, as it has often been found that hemorrhoids may be present in addition to further pathology of much greater importance higher up, we have now established the definite rule never to treat hemorrhoids until the patient has been sigmoidoscoped. As a matter of fact, I have seen several cases of chronic ulcerative colitis which have been completely missed on account of the presence of hemorrhoids. Unfortunately, in some of these cases much damage is done in operating upon the piles because of the slowness with which repair takes place in the presence of chronic ulcerative colitis.

Fissures are frequently the cause of bleeding per rectum, but the diagnosis is fairly easy and definite since there is pain and bleeding at stool, as a rule, and of course one can see the fissure with careful and correct examination. Fistulae also bleed occasionally, but they are less important as a source of blood loss.

Polyps of the colon and rectum can be of great importance as a cause of bleeding per rectum. It is quite possible for a person to have one or more polyps which give no

symptoms whatever and which are found at autopsy. As a general rule, however, polyps will eventually cause bleeding, which may appear in the stool as fresh blood or which may be so slight and so mixed with feces as to make chemical tests necessary for its detection. Here again, it is extremely necessary to eliminate the last 25 cc. or so of large bowel and rectum insofar as polyps are concerned before performing any treatment of hemorrhoids. We have seen a considerable number of cases of patients who have had bleeding from sigmoid polyps and who have been operated upon for hemorrhoids under the mistaken impression that the blood was coming from the rectal veins. Now and then we see a patient who has marked hemorrhage from a polyp high in the colon, although as a rule bleeding from these isolated neoplasms is slight. It has been thoroughly shown[1] that polyps are often precursors of cancer, and for that reason it is most important that they be discovered, if they are the source of bleeding, and properly treated.[2] Even in children one must think of polyps of the colon when there is a complaint of intermittent bleeding per rectum. I have seen five cases in children between the ages of 7 and 3, all of whom successfully underwent transcolonic excision of their tumors. It is interesting to note, in passing, that in two of these children of the same age the polyps were of the same size. However, one patient had been known to have intermittent bleeding per rectum for four years, whereas the other had complained of bleeding for only ten days.

Bleeding per rectum is very frequently found with diarrhea, whether the diarrhea be due to an organism or not. Naturally one should always examine the stool for amebae of amebic dysentery, and for parasities of various types such as ascaris lumbricoidales, ova of parasites, oxyuris vermicularis, etc. In these cases one usually finds a marked degree of anemia, and there is usually a history of travel in southern climates or of eating improperly kept food.

Congenital polyposis deserves a paragraph by itself, as it is without doubt one of the most serious diseases which may be responsible for bleeding per rectum. Although this condition is rare, fortunately it has been the subject of considerable medical literature in the past few years. As a rule symptoms of this disease begin before or during puberty and bleeding is always the most serious sign. Coupled with the terrible diarrhea which is characteristic of this disease, it makes a most difficult and distressing syndrome to treat. Usually polyps will be found upon proctosigmoidoscopy throughout the entire rectum and sigmoid, and contrast barium enemas will show in many cases that the entire colon is involved in every square centimeter. In these cases surgery offers the only hope of cure, and this means complete ablation of the colon or at least the larger part of it.

Changed blood or occult blood, which is frequently found in the examination of the stool, may come from the stomach, esophagus, nasopharynx, duodenum or anywhere else in the gastrointestinal tract.

From the point of view of the proctologist, sigmoidoscopy offers much in the diagnosis of bleeding per rectum. Coupled with roentgenographic studies of the colon, it may be safely said that these two methods of examination will disclose 98 per cent of all colon-rectal pathology. Some may say that an attempt is being made to proctoscope too many patients without sufficient indication for so doing. It may be true that only 1 per cent or so of all hemorrhoidectomies is done in the presence of a carcinoma higher up, but as far as the patient with cancer is concerned that 1 per cent is 100 per cent. In our efforts to control cancer, especially cancer of the rectum and colon, we must not fail to remember that we have two everready aids at our immediate command, one the finger and the other the proctosigmoidoscope. And if to these we add roentgenographic examination, careful history taking and assiduous physical examination, important pathology which may underlie some obvious but minor disease will not be overlooked.

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Case Reports

HOUR-GLASS TUMORS OF THE CERVICAL SPINE*

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THE expression, "hour-glass tumor," is a descriptive term which refers to a morphological characteristic of certain spinal cord tumors. Because of the narrowed portion connecting two enlargements at both ends, the tumor assumes an hour-glass or dumb-bell appearance.

The usual arrangement is for the intraspinal portion to lie either extradurally, which is more common, or intradurally; and for the extraspinal part to lie in the paravertebral region with the narrowed connecting portion extending through the intervertebral foramen. The tumor occasionally passes from the spinal canal by way of the interlaminal space rather than by the intervertebral foramen. This is rare, however. It may lie wholly within the spinal canal, in which case one enlargement lies within the dura and the other outside, with the constriction at the point where the spinal nerve passes through the dura.

It is realized that the present meager literature is not an index to the incidence of the lesion. It is believed that altogether too little consideration has been given this tumor as a clinical entity, inasmuch as it has been more frequently classified and grouped along with spinal tumors according to histological type. It seems desirable to emphasize the clinical aspects because it is highly important that its nature be recognized before operation, so that special technical problems may be worked out beforehand. Craig[1] emphasized this point and reported three cases in which one or more reoperations were performed because of the recurrence of the intraspinal tumor by extension from the unrecognized paravertebral portion. Sometimes, particularly in those lesions in the thoracic area, it is highly desirable to have the co-operation of a thoracic surgeon at operation, as in the case reported by Craig and Harrington.[2] At other times, if the tumor is recognized, it may be advantageous to plan the operation in two stages. Because of these special technical problems the patient can be better served by considering this tumor separately from other spinal cord tumors.

This report is made in order to further emphasize this lesion as a clinical entity, and also to mention a case in which there was a very unusual arrangement as well as extensive development of three cervical tumors.

LITERATURE

The literature is surprisingly meager. A careful search revealed but eight direct references to the lesion. Heuer[3] covered the subject in a very comprehensive manner, while Naffsiger[4] laid stress upon some pertinent points concerning the surgical aspects and added fifteen cases to the literature. Special mention of this tumor in a consideration of other spinal cord tumors has been made, among others[5-11] by Craig, Dandy[12] and Elsburg.[13]

Heuer, in 1929, gathered from his own files and the literature, sixty-four cases. By 1933, nineteen more cases were added,

making eighty-two in all. Since then Craig has reported four cases, Bunts[14] two and Bozzi[15] one.

CLINICAL CHARACTERISTICS

Hour-glass tumors may arise from anywhere along the spine, but most commonly from the thoracic area. Of the cases reported, 27 per cent occurred in the cervical area, 59 per cent in the dorsal, and 12 per cent in the lumbosacral area.

It is with the cervical group that we are especially concerned. I am aware of but twenty-two cases reported or mentioned. It was noted that in only a few cases was a diagnosis made before operation, and these by individuals particularly interested in the lesion. A goodly number were not recognized after the removal of the single spinal or paravertebral portion at operation.

The great majority of these tumors are circumscribed and benign, since they usually arise from the canal membranes, the nerve roots and infrequently the ganglia. There were two reported sarcomas. Of all the patients operated upon, only one tumor could not be removed totally from the canal.

The size of the intraspinal portion of the tumor may vary within moderate limits, but the majority are small or about the size of a hazelnut. They compress, but do not otherwise involve the cord, and lie either within or without the dura, more frequently the latter. The paravertebral portion may vary in size from that of a plumb to an orange and present itself either in the anterior or posterior triangle of the neck. About 80 per cent are visible or palpable. In 16 per cent of the cases reported a paravertebral lesion was not recognized before the operation or autopsy.

The manner in which the growth extends itself has not been definitely decided. Opinions have been expressed that extension is from within out, or from without inward; also that with an origin in the intervertebral foramen the tumor extends both inward and outward. Coenen[16] and Heuer seem to think that a more plausible explanation is that the tumor takes a passive and not an active rôle in determination of its shape; that it is present before the development of the spine, and that the spine impinges upon and constricts it, thus producing the hour-glass contour.

SYMPTOMATOLOGY

In cases of hour-glass tumors of the cervical spine, the principal symptoms are those due to compression of the spinal cord and these in no way differ from the clinical picture produced by other spinal cord tumors in this area, except roentgenographically. An enlargement of the intervertebral foramen, through which the tumor protrudes is frequently noticed and should always be looked for. (Fig. 1.) If present, this enables one to suspect the true nature of the lesion even when the paravertebral portion of the tumor cannot be seen or palpated in the anterior or posterior triangle of the neck.

Root pain, early, before cord signs develop, followed later by numbness, weakness, and atrophy in one of the upper extremities, occurs with tumors of the lower cervical region. The above signs and symptoms may be greatly extended should the paravertebral lesion be large enough to compress the cords of the brachial plexus.

DIAGNOSIS

Recognition of this lesion is not difficult if the lesion is kept in mind when dealing with spinal cord tumors or paravertebral tumors. Before 1930, diagnosis before operation or autopsy was rare, and the dual nature of the lesion was usually discovered after an attack upon the single intraspinal or extraspinal portion. Perhaps Heuer's and Naffsiger's papers played some part as a reminder, for since 1933, recognition has been more common and not the exception as it was before 1929. Enlargement of the intervertebral foramen is pathognomonic of this lesion.

CASE REPORT

J. C. W., female, aged forty-three, was admitted to the hospital June 27, 1937, complaining of a tumor in the left supraclavicular region, of pain and weakness in the left upper extremity and paralysis of both lower extremities.

In August, 1935, (approximately two years before), a tumor had been removed from the left supraclavicular region. Eight months later, in April, 1936, a tumor was again removed from the same place. Although within the next year the tumor had again reoccurred and was palpable, she had not concerned herself with its presence until six weeks ago when she first noticed weakness in the left lower extremity. A little later the right lower extremity was also involved. Twelve days before admission to the hospital, the patient had developed almost a complete paralysis of both lower extremities along with urinary retention.

Examination showed a fairly well developed, undernourished, female, with a scar in the left supraclavicular area. There were numerous cafe-au-lait spots over the body and innumerable cutaneous forms of neurofibromas. In addition, there was a profuse discharge from the right nostril caused by a sinus infection. Both upper extremities were weak, the left more than the right, with definite atrophy of the muscles of the hand and forearm. There was a paraplegia with an accompanying sensory loss. An indefinite sensory line was found over the lower abdomen. The hypaesthesia gradually blended into an anesthesia a few inches above the knees. Slight motor function remained in the thigh muscles. There was a clonus and a loss of sphincteric control. A lumbar puncture revealed an absolute block. Total protein was 1,100 mg. per 100 cc. and 171 mg. in the cisternal fluid. The Wassermann test was negative.

X-rays of the cervical spine showed the seventh cervical intervertebral foramen on the left side to be approximately twice as large as the sixth. There was a thinning of the superior articular facet of the seventh cervical vertebra. The pedicle of the sixth cervical was narrowed. (Fig. 1.)

There were 4,020,000 red cells, 7,500 white cells, polys 90 per cent. The urine was essentially negative.

On July 6, 1937, under local anesthesia, a cervical laminectomy was performed. An intradural tumor was found, producing considerable pressure upon the cord. It was about the size of a pecan and was attached to the eighth cervical nerve on the left side. When the tumor had been freed from the cord and dislodged, it was found that the lateral portion extended on through the intervertebral foramen. The dissection was continued as far lateral as possible and the pedicle sectioned on the outside of the canal. There was a dural attachment. At the time it was difficult to say whether or not this tumor actually arose from the nerve or from the dura. The dural attachment was thoroughly coagulated with the Bovie unit.

Convalescence was uneventful. Two months later, the patient was walking with the aid of walker, and was able to void voluntarily. She gradually regained strength and was able to carry on normally except for a gradually progressive pain in the left upper extremity. A similar pain had been relieved in 1936 by removal of the supraclavicular tumor but returned when the tumor reoccurred. She was sent home for further recuperation.

On February 13, 1938, she returned for the removal of the supraclavicular tumor. She had gained considerable weight and was able to get around in good fashion, and aside from the pain in the left upper extremity, felt well. There was increased atrophy and paresis of the left upper extremity. The left hand was held in the right most of the time. The tumor had become more prominent in the left supraclavicular space.

Under local anesthesia, excising the old scar made in 1936, the supraclavicular tumor was removed. The tumor was followed back to the external margin of the intervertebral foramen, which was large enough to admit the index finger. It was attached to and had distorted the regular positions of the trunks of the brachial plexus. It was freed without injury to any of the nerve elements.

Convalescence was not remarkable. The patient left the hospital nine days after operation. At this time, it was thought that all of the tumor had been removed, at least, none was seen in the supraclavicular area or about the intervertebral foramen.

On March 26, 1939, a little over a year later, the patient returned to the hospital stating that although she was relieved of pain after the last tumor had been removed, that the

pain recurred about six months ago but was a little different in that it radiated down into the hand and the index and middle fingers.

area high up and extending well down into the axilla and onto the arm. The clavicle was bisected and reflected to both sides. The entire
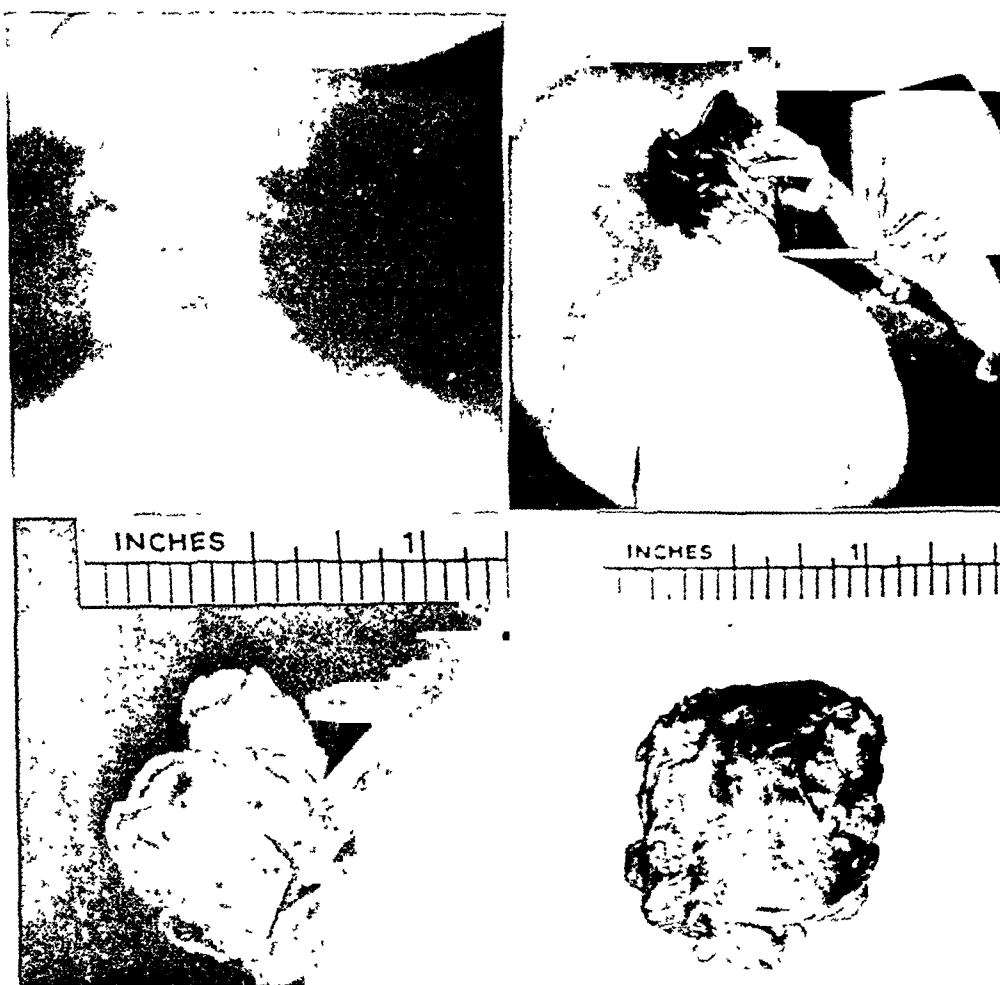
FIG. 1. Upper left; shows enlarged intervertebral foramen; pathognomonic of hour-glass tumors of the spine.
FIG. 2. Upper right: shows cafe-au-lait spots of skin, superficial neurofibromas and operation incision for laminectomy for removal of tumor.
FIG. 3. Lower left: intraspinal portion of hour-glass tumor.
FIG. 4. Lower right: paravertebral portion of hour-glass tumor.

There was about 50 per cent atrophy of the palm and the thenar eminence. Her general condition was good and she had gained about twenty pounds. The extremity had improved in function at first, but again lately there had been a definite decrease in motor function. There was a tumor, palpable in the axilla, which appeared to extend well up under the clavicle into the supraclavicular space. It was firm, encapsulated and slightly mobile.

The laboratory findings were essentially negative.

On March 27, 1939, under local anesthesia, an incision was made in the supraclavicular

brachial plexus was found expanded into a fusiform tumorous enlargement, approximately nine inches long. The tumor was composed of fusiform enlargements of the various portions of the brachial plexus with the normal nerve trunks gradually expanding and becoming a part of the main tumor. There were many ramifications extending from the main tumor body. Some were small and some as large as your thumb, while the tumor itself was larger than one's wrist. The patient was informed of the nature of the tumor and she agreed that she would rather have it removed with the possibility of securing relief from the pain,

particularly inasmuch as the arm had been practically useless to her in the last few months. Accordingly, the various branches of

quite large in size with oval or elongated nuclei. Some huge nuclear forms were present, and many of the nuclei were packed with chromatin
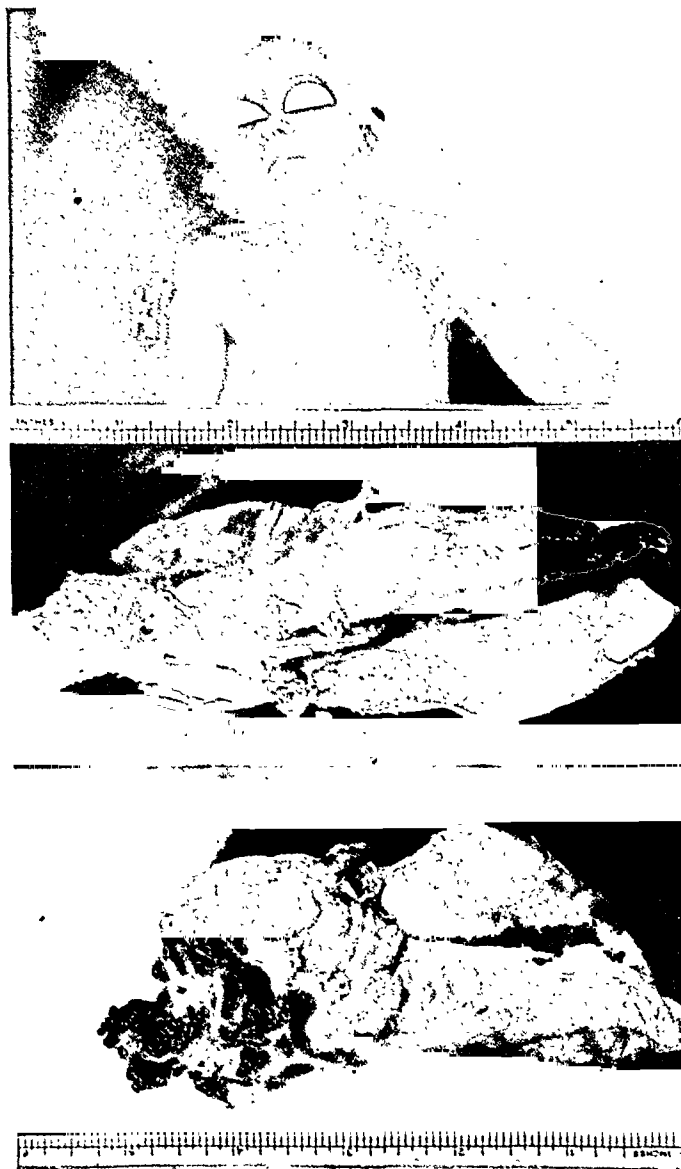
Fig. 5. Top: showing patient and incision for removal of tumor shown in Figures 6 and 7.

Fig. 6. Center: tumorous enlargement of the cords of the brachial plexus.

Fig. 7. Bottom: different view of Figure 6.

the brachial plexus leading into the tumor were exposed and sectioned. Finally the tumor was dissected free from the subclavian artery and vein, and removed intact.

This left the arm without any innervation, yet the blood supply was good and the wound healed well. Convalescence was normal. The patient was able to leave the hospital in twelve days free of all pain. (Figs. 2, 3, 4, 5, 6 and 7.)

Pathologic Report. "The intraspinal tumor was composed of interlacing bundles of spindle cells running in various directions. They were

granules. There was an abundance of giant cells, and most of them were multinucleated. Occasionally plump polyhedral cells were seen. Mitotic figures were present. The tumor appeared quite fibrous in parts.

"The second tumor was found at operation to have been connected with the first, so that the original tumor was of the dumb-bell type. Microscopically it had essentially the same appearance as the first specimen. One of the pieces, however, was much more fibrous. It was composed almost entirely of spindle cells with

very elongated narrow nuclei, tending to run in parallel rows and apparently producing abundant fibrils. In one area ganglion cells were included. The other piece was more densely cellular. The nuclei were packed closely together and the same huge nuclear forms were present as in the first specimen. Many contained very large nucleoli. Giant cells and mitotic figures were again noted.

"The tumor of the brachial plexus was also of similar histological appearance. It contained a great abundance of the giant multinucleated cells. There was marked variation in the size of the nuclei, from small, irregular forms, to very large, round or elongated ones. Mitotic figures were present in this specimen also.

"*Diagnosis.* Neurofibromata of von Recklinghausen type. In view of the mitotic figures present in every specimen, the impression was that the tumors were undergoing a malignant transformation."

COMMENT

Obviously this patient suffered from von Recklinghausen's disease. There were many large cafe-au-lait spots, innumerable small superficial neurofibromas and the deep lesions involving the brachial plexus which had undergone malignant changes. The latter had reoccurred, were operated upon four times and eventually involved the entire brachial plexus. The first two operations at which the paravertebral tumor was removed, the true nature of the lesion was not recognized. It was not until a paraplegia developed that an hour-glass tumor was suspected and verified roentgenographically by the enlarged intervertebral foramen.

When dealing with paravertebral tumors or spinal cord tumors, separately or together, one should bear in mind the possibility of an hour-glass tumor and include in the study of the case a lateral roentgenogram of the spine for visualization of the intervertebral foramen.

SUMMARY

1. The clinical characteristics of hourglass tumors of the spine have been presented.

2. Clinically and from an operative standpoint they should be considered a clinical entity.

3. A case of hour-glass tumor of the cervical spine, associated with huge brachial plexus tumor, was reported.

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PRIMARY CARCINOMA OF THE AMPULLA OF VATER*

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PRIMARY carcinoma of the ampulla of Vater is a rare pathologic condition seldom diagnosed before surgical intervention or autopsy. Due to its strategic location, biliary and possibly pancreatic obstructions occur while the tumor is relatively small and death often occurs due to interference with the vital function of the liver and possibly the pancreas before surgical intervention is accomplished. The case here reported was verified at autopsy.

CASE REPORT

A. H., a woman, aged sixty-four, was admitted to Mercy Hospital on September 2, 1937, with a history of indigestion and pain in the right upper quadrant for two months. The onset was insidious, beginning with pain in the right flank followed by the formation of a mass which gradually increased in size. Jaundice was noted by her friends. Because of the indigestion, her diet had consisted mostly of milk. Her stools had been watery and clay colored, and loss of weight was marked.

Physical examination revealed a poorly nourished, moderately jaundiced senile woman in no apparent distress. There was a slight elevation of temperature. The abdomen was distended and tympanitic. The liver edge was palpable four fingers below the right and left costal margins. The gallbladder was palpable as an extremely large, movable mass, filled with fluid and extending into the right lower quadrant; it was mildly tender and moved with respiration.

The urine contained bile in the majority of specimens, and most of the stool specimens showed blood. The icteric index was 18.6. Blood examination showed 3,400,000 erythrocytes, 9,700 leukocytes, and 71.4 per cent hemoglobin. Duodenal aspiration revealed no bile, and no free hydrochloric acid was found in the gastric analysis. Bleeding and coagulation times were three minutes each. Roentgen-ographic examination showed an enlarged and distended gallbladder, poorly visualized, with cholelithiasis. Barium enema revealed the right colon above the mass.

A preoperative diagnosis was made of obstructive jaundice, probably due to carcinoma of the head of the pancreas or stomach, with cholelithiasis.

Following a blood transfusion, the patient was operated upon on September 16, 1937. A high right rectus incision was made. The gallbladder was found to be greatly enlarged; it was filled with 400 cc. of thin, turbid, pale brown fluid and contained sixty stones varying in diameter from 3 mm. to 3 cm. The wall of the gallbladder was thickened. Several indurated areas were found in the wall which on microscopic examination proved to be moderately rapid growing adenocarcinoma. An infected hydrops (early empyema) was noted. The cystic duct was obstructed and the common duct was indurated and dilated to approximately 2.5 cm. in diameter. A large indurated mass was felt in the ampullary portion of the duodenum, extending posteriorly and upward and involving the head of the pancreas, common bile duct and adjacent glands. The stomach was apparently normal and no metastases were noticed in the liver. Palliative surgery was decided upon; about half the gallbladder was removed and a cholecystostomy performed.

The patient was discharged from the hospital on October 12, the twenty-sixth postoperative day. The jaundice had cleared and she had no pain. Weight loss and emaciation were progressive. A moderate amount of purulent, foul smelling drainage persisted until her death on February 16, 1938, four months after operation.

Autopsy by Dr. John Sheehan revealed a deep ulcer in the duodenum, 2.5 cm. in diameter, replacing the ampulla of Vater and tissues adjacent to it. The wall and base of this ulcer were composed of tumor, found microscopically

to be a poorly differentiated adenocarcinoma. The common hepatic duct ended abruptly in the cavity produced by ulceration. The tumor

not be ruled out absolutely, the large ulcer in the duodenum, a pancreas negative except for invasion of the head immediately adjacent to

FIG. 1. Photomicrograph showing a section of the wall of the ulcer in the duodenum. Upper free edge of specimen represents portion of wall of hepatic duct; epithelium absent. Wall and tissues around duct are heavily infiltrated by tumor. × 100.
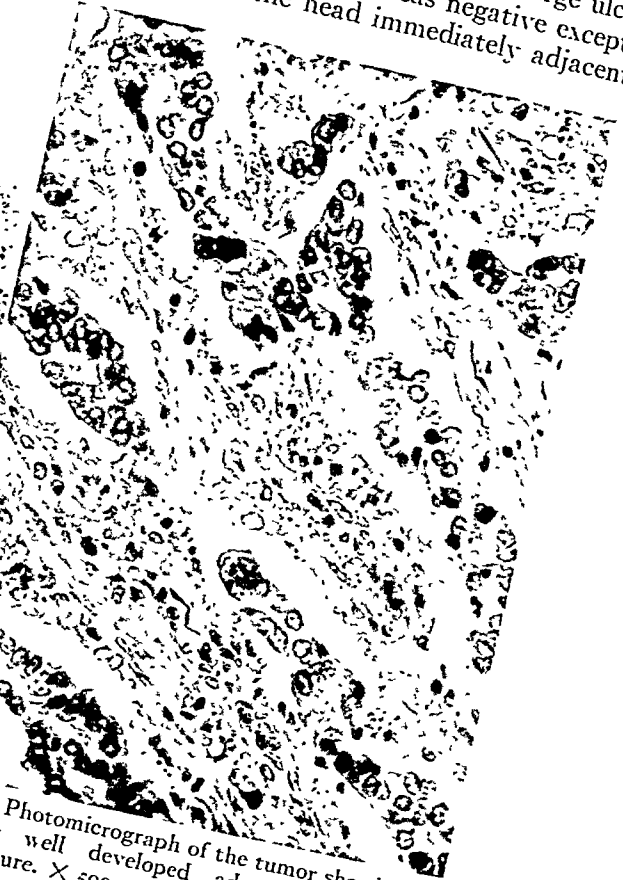
FIG. 2. Photomicrograph of the tumor showing a fairly well developed adenocarcinomatous structure. × 500.

in the wall of the ulcer extended outward from the ulcer, replacing the neck of the gallbladder and invading part of the head of the pancreas. It permeated the tissue of the lesser omentum, passing posteriorly to the hepatic ducts and portal vein, and invaded the liver. Lymphatic permeation of the wall of the gallbladder by tumor and diffuse replacement of much of its mucosa by tumor were noted, but there was no single mass of any appreciable size in the gallbladder and no marked involvement of any portion of its wall. (A hydrops of the gall-bladder had been noted at operation.) The only metastasis found was in the upper aortic nodes. The pancreas was normal except for involvement of the head immediately adjacent to the tumor. (Figs. 1 and 2.)

While origin of the tumor in the head of the pancreas or in the neck of the gallbladder could

the ulcer, and a relatively slightly involved gallbladder pointed to an origin in the ampulla of Vater as the most logical possibility.

The only other significant findings at autopsy were a suppurative cholangitis with multiple fairly large abscesses in the right lobe of the liver, a moderate splenomegaly, ascites and a left hydrothorax. The portal vein and the right and left hepatic bile ducts were pushed forward and compressed by the tumor in the lesser omentum.

DISCUSSION

Primary carcinoma at the ampulla of Vater, according to Mayo-Robson[1] was probably first described by McNeal in 1835 (North American Archives, Baltimore) and was later drawn attention to by Stokes in 1846 (Dublin Quarterly Journal of Medical Science). Rolleston[2] states that Busson, in 1890, collected eleven cases and Hanot and

Georges, in 1896, contributed to the subject. In 1898, Halsted[3] successfully resected an ampullary carcinoma and since that date the subject has attracted more widespread attention. In the succeeding years Schüller,[4] Outerbridge,[5] Cohen and Colp,[6] Hunt and Budd,[7] Whipple, Parsons and Mullens,[8] and others contributed to the literature. Cooper[9] in 1937 reviewed the subject and added to the literature fourteen cases observed in the New York Hospital between the years 1915 and 1935. Hoffman and Pack[19] in the same year in a review of 228 reported cases of carcinoma of the small bowel found 104, or 45.6 per cent in the duodenum, of which 61.9 per cent were at the ampulla of Vater.

The average age incidence in Rolleston's[2] and Outerbridge's[5] combined series was 54.9 years; the youngest reported case was in a patient of thirty years (Mayo-Robson),[1] while a patient of eighty-one years is mentioned in Rolleston's series.

Males are affected more frequently than females by a ratio of 2:1.

Cholelithiasis apparently is not a strong etiologic factor in this type of carcinoma. In Cooper's series,[9] 22 per cent gave a history of having suffered from gallstones. Duodenal peptic ulcer has been cited as a possible cause. This is questionable since duodenal ulcers and carcinoma of the ampulla of Vater rarely or never exist in the same patient. Embryonal pancreatic rests are mentioned in the literature as a possible etiologic factor. These aberrant rests do occasionally occur in and about the second portion of the duodenum but, according to Branch and Gross,[11] seldom undergo carcinomatous changes.

In many cases the histogenesis of the tumor cannot be determined because the entire ampullary region may be involved. The microscopic sites of origin may be from any of the following tissues: (1) epithelial lining of the ampulla of Vater; (2) duodenal epithelium of the peri-ampullary region or of the duodenal papilla; (3) epithelium of the terminal common bile duct or of the terminal pancreatic duct;

(4) Brunner's glands in the submucosa of the papilla, or (5) aberrant pancreatic tissue.

Two distinctive types of tumors are recognized, namely, the papillary and the ulcerating, with variations between the two extremes. The tumor may vary from a few millimeters to more than 3 cm. in diameter. The patient becomes jaundiced if the common bile duct is obstructed. In the ulcerating type this jaundice may be characterized by remissions and exacerbations due to the rapid growth of the tumor followed by ulceration and release of the obstruction. Columnar cell adenocarcinoma with cells arranged in alveoli or pseudo-alveoli is the most common type. Some of the rare varieties reported are colloid carcinoma (Walters),[12] squamous cell carcinoma (Cohen and Colp),[6] and scirrhus carcinoma (Arnsperger, quoted by Cooper).[9]

Malignant tumors of this region other than carcinoma are exceedingly rare, but the following types have been reported: Spindle cell sarcoma (Moll),[13] melanoma (Jones),[14] melanoma (probably carcinomatous) (Duval),[15] and lymphosarcoma found at necropsy at the Cook County Hospital by the late Dr. Jaffé.

A few benign ampullary tumors have been reported. In 1933, Christopher[16] in reviewing the literature found forty-one cases and added a benign adenoma. In 1934, Landivar[17] added a papilloma.

Metastasis occurs in from 20 to 36 per cent of the cases, according to various investigators; however, many times death supervenes rapidly before metastasis has had time to occur. Primary carcinoma of the ampulla of Vater metastasizes in the following manner: (1) local extension to the pancreatic lymph nodes, to the second portion of the duodenum and to the pancreas through the intimate relationship of the lymphatics; (2) lymphatic extension to the periportal lymph nodes at the hilus of the liver and the pre-aortic nodes, and (3) visceral metastasis via the lymphatics to the liver most frequently; unusual metas-

tases are to the lungs, pleura, peritoneum and omentum.

Due to the obstruction of the ducts and the infections which may occur, pathologic changes are present in the liver, pancreas, gallbladder and biliary ducts. The liver is smooth and enlarged. Multiple hepatic abscesses and a suppurative cholangitis are common in the ulcerating ampullary tumors in which the opportunity for infection is great. The head of the pancreas is hard and nodular. The common and hepatic ducts are dilated and sometimes the cystic duct will be dilated also. The gallbladder is usually greatly distended and palpable but not tender.

In most patients a past history of biliary colic may be obtained. There is an onset of epigastric or right upper quadrant pain, either cramp-like or burning; an increasing obstructive jaundice follows which may be constant or intermittent in character. If the jaundice persists, chills and fever of the intermittent Charcot type may occur. General pruritus, acholic stools and dark urine are noticed. Loss of weight is rapid, and if the carcinoma is of the ulcerating type blood in the stools is quite characteristic together with a marked anemia. Diarrhea may be present. Anorexia is usually a prominent symptom. Vomiting is not common and when it does occur no bile is found in the emesis; continued vomiting indicates duodenal obstruction. Ascites may occur but is rare.

Obstructive jaundice, diarrhea and intestinal bleeding are considered by some authorities to be diagnostic features. Courvoisier's law is also an aid in diagnosis. Roentgenography may be of value by the following findings: (1) obstruction with dilatation of the first part of the duodenum and stomach; (2) filling defect of the duodenum; (3) duodenal flattening from behind, and (4) irritability of the second part of the duodenum.

An attempt should be made to differentiate carcinoma of the ampulla of Vater from other tumors which cause a palpable gallbladder, the most common being carcinoma of the head of the pancreas and carcinoma of the common duct. This is difficult to establish but persistent occult blood in the stool, anemia and roentgenographic changes in the second portion of the duodenum are helpful.

Primary carcinomas of the ampulla of Vater are operable early and are treated either by palliative or radical operation. Palliative operative procedures, cholecystostomy or cholecystogastrostomy, are performed when the more radical procedures are contraindicated. Transduodenal resection with reimplantation of the duct has been the procedure most commonly employed, when the tumor was small, papillary, free of ulceration and without infiltration. The surgical mortality, however, is high and recurrence may ensue.

Since the expectancy of life is very short in malignancies of this region, the operation of choice should be, if possible, the two-stage wide resection of the duodenum as described by Whipple and his associates,[8] in both the papillary and ulcerating types of lesion, if any hope of a cure is to be expected.

SUMMARY

A case of primary carcinoma of the ampulla of Vater is reported, together with a review of the literature, an outline of the outstanding symptoms, points in differential diagnosis and the methods of treatment.

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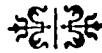
IN dealing with cardiacs, one should remember that over dehydration is just as bad for cardiacs as for normals, but unlike normals, cardiacs are in grave danger from too much fluid.

From—"The Heart in Pregnancy and the Childbearing Age"—by Burton E. Hamilton and K. Jefferson Thomson (Little, Brown and Co.).

SPONTANEOUS RUPTURE OF UTERUS IN FOURTH MONTH OF PREGNANCY*

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RUPTURE of the antepartum uterus is one of the most infrequent accidents of pregnancy. So unusual is this condition that some textbooks of obstetrics fail to mention it, others merely mention the possibility while discussing rupture of the parturient organ. DeLee,[1] Curtis[2] and Beck[3] uniformly agree that it is very unusual if one excludes perforation of the uterus by criminal abortionists. Baisch[4] in 1903 collected seventy-eight cases of rupture of the uterus during pregnancy and added a case of his own in which the accident occurred during the thirty-sixth week. Of the seventy-nine cases only thirty-one occurred during the first five months of pregnancy. In 1904 DeLee[5] reviewed the literature and presented a case in which indirect trauma caused the rupture of a uterus in the eighth month. Kane[6] in 1923 reported a case of spontaneous rupture of the body of the uterus in the sixth month of pregnancy.

Riddell[7] has classified these cases into three types: (1) cases in which no gross anatomic defect is present, in which the predisposing cause is a diseased, degenerated or previously injured uterus, with indirect violence frequently the exciting cause; (2) cases in which there are gross lesions, such as interstitial pregnancy, pregnancy in a rudimentary horn of a bicornuate uterus, new growths, hydatidiform mole, or rupture of the scar of a previous cesarean section (the latter, because of the increasing popularity of cesareans, is responsible for most); (3) traumatic ruptures due to wounds by such instruments as sounds, curettes, bullets, or by crushing or other forms of violence.

A digest of the more recent literature affords us examples, though relatively few in number, of the more frequent predisposing etiologic factors. Snidow[8] reported the spontaneous rupture of a uterus in the sixth month of pregnancy, in which there had previously existed a severe puerperal endometritis. Gordon[9] operated on a ruptured uterus in which pregnancy had occured in the closed rudimentary horn of a bicornuate uterus. Yule[10] had a patient in whom spontaneous rupture had occurred during the fifth month in a uterus which was the seat of fibroids. Fletcher[11] reported a patient who had a spontaneous rupture of the uterus in the eighth month one and a half years after a curettage for subinvolution following a miscarriage. Lankowitz's[12] patient likewise had a spontaneous rupture during the fifth month following a previous abortion and curettage. Ivanow,[13] Baird[14] and Swift[15] all report spontaneous rupture of pregnant uteri which had previously been subjected to cesarean sections. Ridell and Scholefielf[16] sutured a 4 inch rent in the right cornu of a uterus thirty-two weeks pregnant in which spontaneous rupture had occurred without violence and without any antecedent history.

To this group of unusual cases we add another. Spontaneous rupture occurred in the right cornu of a three and a half months pregnant uterus sixteen months after a salpingectomy had been done on the same side. In addition a recent corpus luteum was found in the ovary on the same side.

CASE REPORT

Mrs. F. L., 25 years old, white, never before pregnant, was operated on at the Jewish

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Hospital of Brooklyn on July 17, 1938. A right salpingectomy was performed. The pathologic report showed papillary adenocystoma of the

examination, the cervix was soft and slight manipulation caused such pain that further examination was not done. Because of the

FIG. 1. Uterus with rupture at right cornu; fetus extruded; placenta in situ.

right tube. Her history previous to this operation was essentially negative. Menses started at 13, occurred regularly every twenty-eight days and lasted four days There had been no previous illnesses.

Her last menstrual period began on August 13, 1939. On October 5 she had dull aching pain in the right lower quadrant. Pregnancy was diagnosed by one of us (S. B. S.). The patient felt well until November 11, when at 8 P.M., during bowel evacuation, she felt weak and faint, but had no pain. After trying to help the patient with home remedies, the family sought medical aid. Examination at 10 P.M. (by M. J. R.) revealed a marked pallor with blanched mucous membranes. The patient was cold and clammy. Temperature was 97°F., pulse 60, blood pressure 60/40. The lower abdomen was moderately distended and presented a midline lower abdominal scar. Tenderness over the lower abdomen was definitely more marked on the right side. Upon vaginal

catastrophic picture we believed that we were dealing with intra-abdominal hemorrhage and diagnosed ruptured cornual pregnancy.

Morphine sulfate gr. $\frac{1}{4}$ and atropine sulfate, gr. $\frac{1}{150}$ were given, external heat was applied and the patient was placed in the Trendelenburg position while awaiting the arrival of the ambulance.

On her admission to the hospital at 11.45 P.M., temperature was 97.8, pulse was 104 and of poor quality, and blood pressure was unobtainable. The patient was immediately typed for transfusion and sent to the operating room. Under ether anesthesia the old operative scar was excised and the abdomen opened. The peritoneal cavity was filled with blood, estimated at 2,000 c.c. The uterus was about the size of a four months' pregnancy with a rupture in the right cornual end, the fetus partly protruding through this rent into the peritoneal cavity. The right tube was missing, having been removed at the previous operation. The

right ovary was the seat of a corpus luteum. The left tube and ovary were normal. The upper half of the uterus at the site of the rupture was markedly thinned out and the rupture measured about 6 cm. A direct blood transfusion of 600 c.c. was given during the course of the operation.

Because of the marked thinning of the upper portion of the uterus, it was impossible to preserve much uterine tissue, and a high supracervical hysterectomy was performed, leaving as much of the lower uterine segment as possible. It is questionable whether enough uterine tissue was preserved to maintain menstruation. Both ovaries and the left tube were left in situ. Raw surfaces were peritonealized and the large blood clots were removed. The wound was closed in layers without drainage. After completion of the direct transfusion a venoclysis of 5 per cent glucose in saline was administered.

At the termination of the operation the patient was still in shock, pulse and blood pressure were unobtainable She was kept on the operating table in Trendelenburg position, external heat was applied, caffeine was administered and oxygen was supplied by inhalation. After an hour the pulse and blood pressure returned and at 2.30 A.M. a transfusion of citrated blood by the drip method was started, 600 c.c. of blood being administered. At 5.30 A.M. the pulse was 92 and the blood pressure was 100 systolic, 42 diastolic. At ~ A.M. the patient was taken to her room.

Thereafter her postoperative course was uneventful and her recovery prompt. Hemoglobin rose from 47 per cent postoperatively to 70 per cent before her discharge and the red blood corpuscles rose from 3,000,000 to 3,900,-000. The wound healed by primary union, the sutures were removed on the seventh day and the patient was discharged twelve days after the operation.

Pathologic Report (Dr. David M. Grayzel). The gravid uterus measured 9.5 by 9 by 4 cm. At the fundus there was an irregular opening 6 by 3.5 cm., with ragged edges, which communicated with the uterine cavity. Protruding from this opening was a portion of spongy tissue pink and gray in color, and several blood clots measuring 7 by 5 cm. Similar tissue protruded from the internal os. The uterine canal was filled with spongy pink, gray and red masses. The myometrium measured 2.5 cm. in

thickness at its thickest part and was pink and trabeculated. There was a male fetus 14 cm. in length.

In a microscopic preparation from the placenta, well formed chorionic villi were seen lined by Langhans and syncytial cells. The connective tissue cores were loose and contained markedly engorged capillaries. Syncytial giant cells were numerous, and attached to some of them were sheets of decidual cells. The endometrium was broad and its surface partly covered by cylindrical cells. Endometrial glands were numerous and large, corkscrew in appearance and widely distended. The lining cells were tall and columnar with abundant cytoplasm and vesicular nuclei. The lumina contained amorphous pink and lavendar-staining material. The stroma was loose and in places contained large decidual cells. The muscular coat was broad and the muscle fibers large and broad. The vessels everywhere were widely distended.

Other preparations showed extensive areas of extravasated blood in which poorly preserved chorionic villi and numerous syncytial giant cells were scattered. The remainder of the wall consisted of bundles of large smooth muscle cells separated by loose connective tissue in which are seen distended blood vessels.

SUMMARY

A case is presented of spontaneous rupture of the uterus in the fourth month of pregnancy. This rupture took place in the region of the right cornu at the site of a salpingectomy performed sixteen months previous. The corpus luteum was seen in the right ovary. It is interesting to observe that in this case pregnancy occurred by migration of the ovum from the right ovary to the left tube.

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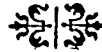
WE can conclude that there is no substantial evidence that pregnancy tends to protect against, and only the faintest evidence of slight tendency to induce, recurrence of rheumatic fever in women with chronic rheumatic heart disease, or in women who have had rheumatic disease but have been left with apparently sound hearts.

From—"The Heart in Pregnancy and the Childbearing Age"—by Burton E. Hamilton and K. Jefferson Thomson (Little, Brown and Co.).

CONGENITAL CICATRIZING BANDS[*]

REPORT OF A CASE WITH ETIOLOGIC OBSERVATIONS

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CONGENITAL abnormalities have always been of interest to the casual observer and the anatomoembryologist. Many victims of such abnormalities have become wards of the state because of their disability. Others with minimal defects suffer little restriction of their activities.

The following is an account of a patient with congenital constricting bands of the fingers and toes with amputation and a deep constricting band of the right leg. This patient, in spite of the marked anatomical changes, has lived comfortably for about seventy years and his case lends support to the theory of "focal necrosis of limb bud tissue" occurring in early embryonic life.

CASE REPORT

C. S., a white man, aged seventy-two, came to the Dermatologic Out-Patient Department of the Hospital of the University of Pennsylvania in March, 1939, because of swelling of the right foot and a mild pruritic erythematous dermatitis on the posterior aspect of the right leg.

The family history contained no relevant congenital abnormalities or factors. At birth the patient was normal except for a constricting band around the distal portion of the right leg, annular creases around some of the fingers of both hands with a partial syndactylism of the fourth and fifth fingers of the right hand. His father removed with scissors remnants of the left index finger and fifth finger which were represented at birth by fibrous strands attached to the soft tissues proximally. At birth the right foot was the same size as the left, except for the structural differences to be described. His right foot has always been cold and somewhat cyanotic. At the age of twelve, his right foot was frost-bitten and because of possible

gangrene, amputation was advised but was refused by his family. The patient had no further trouble with the foot for the following sixty years.

In October, 1938, he noted swelling of the right leg below the constricting band. About January, 1939, the edema spread above and below the constriction. It was accentuated by walking and standing, was relieved by rest and elevation of the leg and was usually associated with dull throbbing pain. The edema was still present when the patient was seen by me in March, 1939, because of a pruritic dermatitis on the right calf.

Physical examination showed the patient to be a well preserved man of seventy-two years, weighing 150 pounds. He walked with the aid of a cane. The physical examination was essentially negative except of the condition of the extremities.

The right hand (Fig. 1) had a constricting annular band around the first phalanx of the index and middle fingers with incomplete syndactylism of the fourth and fifth fingers. The left hand had similar annular crease-like bands around the first and second phalanges of the middle and ring fingers. The left index and fifth fingers were missing from the distal end of the metacarpal bones.

The right leg (Fig. 2) had an hour-glass appearance produced by a fibrous, scar-like constricting band completely around the junction of the middle and lower thirds. The measurements of the circumference of the leg were: above the band, thirteen inches; at the band, seven inches; and below the band, thirteen inches. The leg at the site of the band consisted essentially of the fibrous band and the two leg bones. The latter were easily palpated. The right foot had a bulbous appearance and the first two toes were only rudimentary structures. The dorsalis pedis and the tibial arteries were not palpable. The lower part of the left leg was normal and measured nine

inches in circumference. The fourth and fifth left toes were absent and the second and third left toes had constricting annular creases over
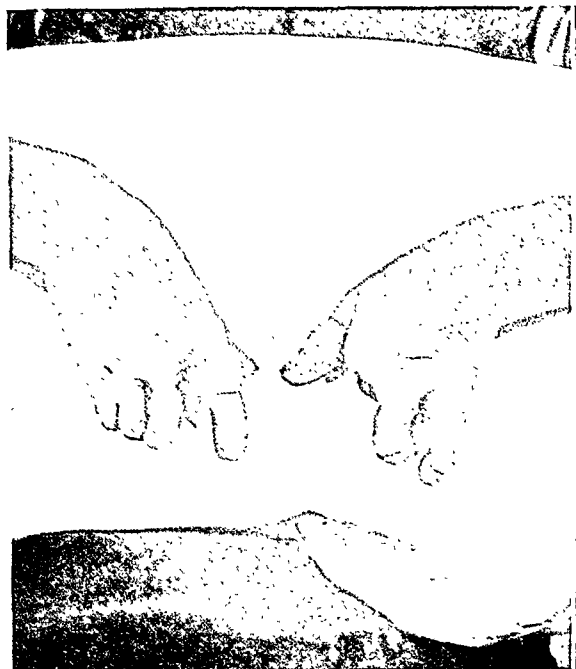
FIG. 1. Partial syndactilism with annular crease formation and amputation of fingers.

the middle phalanges. The movements of the feet were normal.

A complete survey was made of the skeleton. This revealed hypertrophic changes of the vertebrae and an increase in the number of small bones in the hands and feet. The bones of the right leg were negative. (Fig. 3.)

Oscillometric study[1] showed somewhat greater deflections than normal in the right foot but in the left foot they were normal. This meant that there was some organic obstruction to the blood flow in the right foot or there was a vascular spasm secondary to local change. There was actually a larger vascular bed in the right leg than in the left.

Laboratory studies including blood count, blood cholesterol, blood urea nitrogen and calcium were within normal limits. The Kolmer, Kahn and Kline reactions were negative.

Rest in bed made the leg smaller and a short walk induced slight edema. Excess walking, however, caused a relapse of the dull throbbing pains and a reappearance of the hour-glass contour of the right leg. Although there was a possible risk of injury to the tibial vessels, excision of the constricting band was advised to allow for better venous and arterial circulation. The patient refused any surgical interference.

ETIOLOGY

Defects similar to those in my patient have been classified by some recent authors
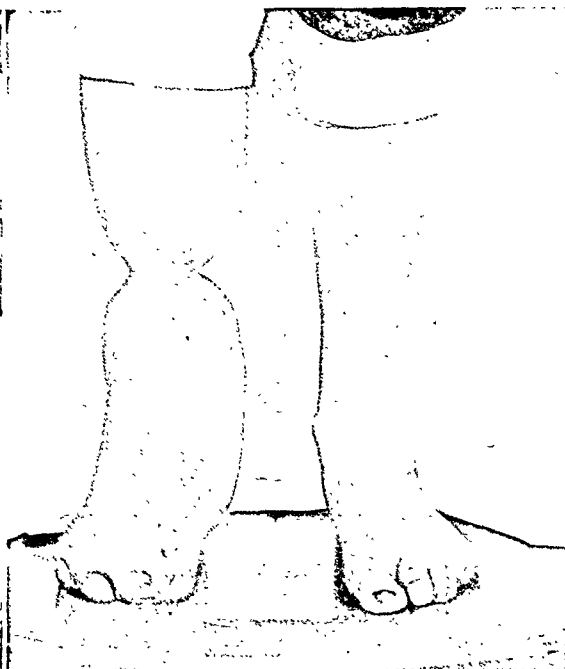
FIG. 2. Hour-glass appearance of right leg following progressive vascular instability. Note the amputated stumps and malformation of digits of toes.

under the general heading of spontaneous intra-uterine amputations. Many theories have been proposed to explain the development of constricting fibrous bands which may partially sever or completely amputate a finger, toe, arm or leg. The most important of the etiologic explanations of this congenital abnormality will be discussed briefly under the following heads: (1) ainhum; (2) relation to premature loss of amniotic fluid or to amniotic bands; (3) amputation by umbilical cord; (4) defective central nervous system development; (5) disturbance of the endocrine mechanism controlling bone formation; and (6) focal necrosis of limb bud tissue.

Ainhum (to saw or cut) recently studied by Horwits and Tunick[2] seems to be a process somewhat similar to that in my patient. This disease consists in a slow, gradual linear strangulation of one or more toes, especially the fourth and fifth and occasionally the fingers are involved, eventually resulting in spontaneous amputation. The groove or crease is usually located at the first interphalangeal joint. This condi-

tion is usually seen in negroes but has been reported in the white race. It may occur in childhood or in later life and, since it does
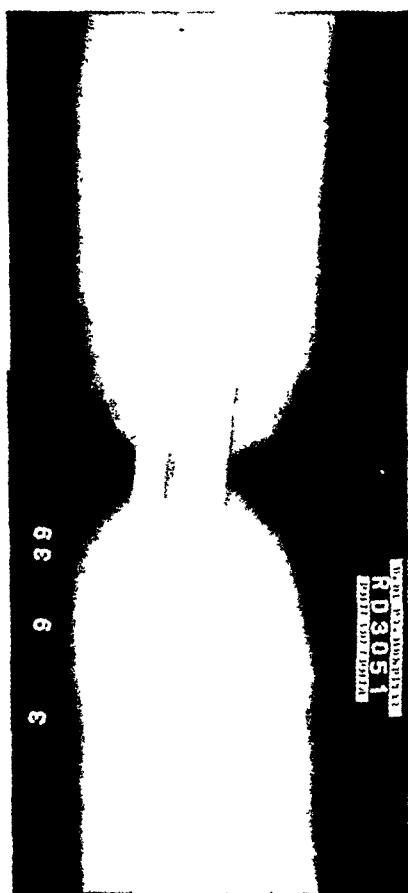
FIG. 3. Complete absence of any osseous change resulting from the fibrous encirclement.

not occur prenatally, differs from the case presented.

Duncker,[3] Linzenmier and Brandes[4] believed that the premature loss of amniotic fluid was a likely cause of these deformities. Debrunner[5] and Berkely[6] thought that amniotic strips of bands may be traumatic and could cause amputation of the fingers, toes or extremities. Latta[7] held a somewhat similar opinion that bands of fibrous nonvascular tissues, apparently amniotic in origin, encircle the limbs at different times in fetal life. Rapid growth of these bands may cause progressive constriction until amputation is the result.

The possibility of the encircling of an extremity by the umbilical cord was em-phasized by Battle,[8] Huguet[9] and many others. Abbe[10] believed that the digits of an infant cannot be amputated by a cord several times larger than a digit, even if it remained surrounding the extremity for some time. The popular idea of intra-uterine amputation caused by the umbilical cord is held by the laity and many physicians today; but it seems logical to conclude that an umbilical cord, twisted about a limb with sufficient tension to produce amputation or crease formation, would so depress or completely obstruct fetal circulation as to result in fetal death.

Abbe was convinced that the association of such lesions as clubfoot, spina bifida or cranial anomalies with skin grooves strongly suggests that the so-called congenital amputation is really a condition of nondevelopment. This probably is due to a deficiency in the control of the developing tissues of the central nervous system.

It has been suggested by Dock[11] that the frequent association of amputation with other deformities raises the question as to the possibility of a disturbance of the endocrines which control bone formation and growth. There is no concrete evidence to support this view.

Streeter[12] in his excellent monograph stated that intra-uterine amputations are not due to constricting bands in utero, but are primary congenital changes due to abnormal constitution of the germ plasm. He believed that there is no evidence that intra-uterine amputation is due to amniotic bands, adhesions or mechanical constriction, but that there is a normal disparity in the quality of vitality of different tissues of the body, which is inherent in the germ plasm. Streeter also believes that a defective development of circumscribed areas of the limb bud tissues in the embryo are of such inferior quality that imperfect histogenesis occurs. Whether injured or defective in some way, these areas maintain themselves only through the earlier weeks of pregnancy. By the fourteenth week they become fibrous masses sloughing away from the normal adjoining tissues. At birth

an adjustment has been made and one finds traces of the damage in the form of depressions, grooves and healed stumps, occasionally with slender residual strands of hyalinized material still adhering to the affected regions. It is this material which has been mistaken for amniotic bands. In many cases in which annular zones are not deep enough to interrupt the circulation, the only defect is the presence of a crease.

The theory of germ plasm deficiencies has been further elaborated by Bagg[13] who followed descendants of mice treated with roentgen rays. These descendants showed a high percentage of congenital defects through several generations. Of 5,280 mice treated with roentgen rays which had been followed for a number of generations, 300 had clubfeet, many had polydactylism, hypodactylism and numerous other congenital defects, such as absence of kidney, testes, abnormal liver, or blindness, alone or associated with the above changes.

DISCUSSION AND SUMMARY

A case of spontaneous congenital amputation of the fingers with annular Ainhum-like bands and constriction of the distal portion of the leg with edema has been described. Theories for the possible explanation of the genesis of congenital bands and spontaneous amputations have been presented.

This congenital anomaly is a rarity in medical practice since similar cases in an embryological laboratory which receives many of the monstrosities and curiosities of medicine are conspicuous by their absence.

Streeter's theory that focal necrosis of the limb bud tissues occurs during the developmental embryonic stage seems the most plausible explanation. According to this theory the damage occurs during the first five weeks of embryonic life and the residua are apparent at birth. The absence of several fingers and toes in my patient

may have occurred in early embryonic life as a result of focal necrosis. Other digits had cicatrizing bands but were not spontaneously amputated because the underlying process stopped in time.

The interesting feature of this congenital defect was the ability to live a normal life without earlier circulatory embarrassment. His present condition is probably the result of senility and weakened vascular bed, and not due to the presence of slowly progressive shrinking of the fibrous band that encircles his right leg. With increased edema and deficient vascular supply gangrene may later ensue.

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BILATERAL TRAUMATIC DIAPHRAGMATIC HERNIA

REPORT OF A CASE

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THOUGH occasional reports in the literature indicate that congenital or traumatic herniae of the diaphragm may extend across the midline, thereby being bilateral in the sense that the defect involves both sides, the incidence of separate herniae of the diaphragm which are bilateral is apparently exceedingly rare. We have been unable to find a report of a single case of bilateral traumatic diaphragmatic hernia of this type.

CASE REPORT

R. G. D., age 50, white, civil engineer, veteran officer of the World War, was admitted to Walter Reed General Hospital on January 6, 1939, for the treatment of "a hernia of the left side of the diaphragm which involved the pericardial sac." He had been injured in an automobile accident in April, 1934, at which time, fractures of the left ribs and the pelvis and a dislocation of the right shoulder had occurred. After six weeks' hospitalization he returned to his work without complaint. However, in October, 1934, while under treatment for urticaria, he was found to have a hernia of the left side of the diaphragm. Except for a feeling of fullness after eating, he had no complaint until about March, 1937, when he sought treatment because of gaseous abdominal distention and a sense of fullness before the completion of a meal. At this time he was examined and a gastrointestinal x-ray series showed that the pyloric portion of the stomach, the duodenum and the first portion of the jejunum were within the pericardial sac. There was approximately 50 per cent retention of barium in the stomach after five hours. On reëxamination in September, 1937, the hernial sac was found to be larger, with a portion of the transverse colon in the pericardial sac. Upon examination in June, 1939 the hernia was found to be even larger with a loop of transverse colon reaching the upper limits of the pericardial sac.

During the years 1937 and 1938, the patient had lost 50 pounds in weight, and had vomited occasionally after eating. During the last few months of 1938 the vomiting had increased in frequency. In December, 1938, he had a severe cold from which recovery was slow and accompanied by considerable loss of energy. Because of this complaint he decided to enter the hospital.

On admission he was found to have a normal temperature and a normal pulse and respiratory rate. He was ambulatory, though weak and in a state of moderate emaciation. Eyes, ears, nose and throat appeared normal. The mucous membranes were slightly pale. The skin was dry and showed evidence of loss of weight. The normal weight was 154 pounds, but the patient weighed only 104 pounds at the time of admission. There was no apparent abnormality of the glandular system. The peripheral vessels were of normal elasticity, the pulse was of poor volume and the pulse rate was rapid on exertion. The blood pressure was 100 systolic and 70 diastolic. Examination of the lungs showed marked diminution of breath sounds in the lower half of the chest on the left side; the lungs elsewhere were normal. The heart was difficult to outline by percussion though it was apparently within normal limits. The heart sounds were distant in the region of the apex but no murmurs or thrills were present. The abdomen was soft and no masses were palpable, though the left upper half was moderately distended. The veins of the abdominal wall in the epigastric region were prominent. No pathology was noted on examination of the nervous system, muscles, joints or osseous system.

Laboratory Data. The urine was found to contain one plus albumin and occasional leucocytes on repeated examinations. The specific gravity varied from 1.010 to 1.020. Blood count on admission showed 4,580,000 red cells per c.mm. with 80 per cent hemoglobin, and 8,400 leucocytes with 50 per cent lymphocytes,

1 per cent monocytes, 48 per cent neutrophilic and 1 per cent eosinophilic polymorphonuclear cells. The coagulation time was

on January 29, 1939, the blood chemistry determinations showed urea nitrogen 78.94, sugar 90.9, chlorides 297 and creatinine 3 mg.
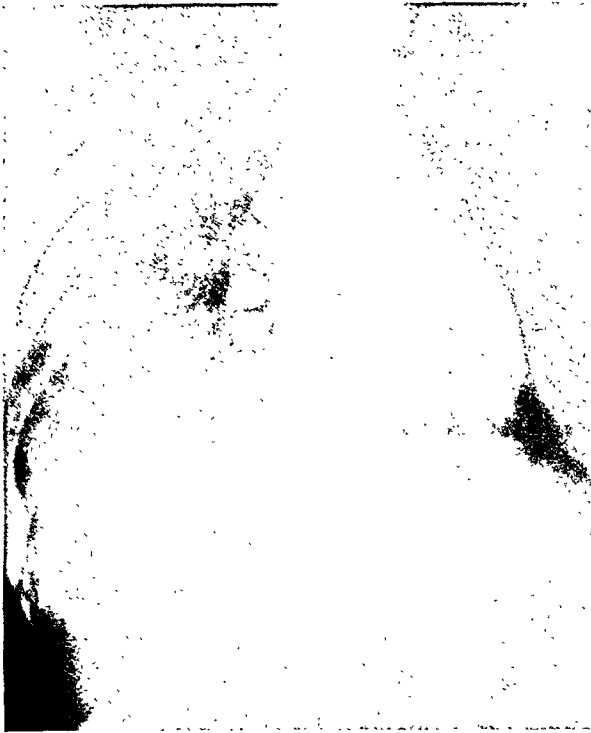
FIG. 1. Barium enema before operation, showing presence of the transverse colon in the pericardial sac. (Courtesy of Dr. F. M. McChesney and Dr. Claude Moore.)

FIG. 2. Lateral view of the chest before operation and after a barium enema, showing the position of the colon in the pericardial sac.

three and one-half minutes and the bleeding time two minutes. The Kahn reaction was negative. Electrocardiographic study indicated a regular sinus rhythm, a left axis deviation of 50 degrees and slight slurring of the QRS in lead II; the duration of the QRS was 0.12 seconds, indicative of defective intraventricular conduction. X-ray examinations, including gastrointestinal series, barium enema and examination of the chest (Fig. 1), showed a hernia of the left leaf of the diaphragm. The stomach was found to be within the abdominal cavity in the upright position but the pars pylorica and pars media were within the pericardial cavity in the prone position. The right leaf of the diaphragm was found to be elevated. The midportion of the transverse colon passed through the diaphragm and ascended to the level of the third rib. On lateral examination the portion of the transverse colon within the chest was seen anterior to the heart. (Fig. 2.) The lungs were free of pathologic changes, and the aorta and heart were in normal position.

During the first two weeks in the hospital the patient vomited frequently after meals and

per 100 cc. of blood. The CO_2 combining power was 47.5 volumes per cent. After the intravenous administration of hypertonic saline solution and 5 per cent glucose in normal saline solution, the blood chloride level was increased to 412.5 while the urea nitrogen decreased to 42.85 and creatinine to 2.6 mg. per 100 cc. of blood. This aided materially in decreasing the frequency of vomiting.

On February 6, 1939, a left phrenemphrexis was done under local anesthesia. X-ray examinations on February 9, 1939, demonstrated a paralysis of the left diaphragm.

On February 17, 1939, at operation under spinal (novocaine-nupercaine) anesthesia, an opening was made into the abdominal cavity through a left upper abdominal incision which paralleled the left costal margin. A very large defect was found in the left diaphragm which would admit the entire hand. The distal half of the stomach, approximately 15 inches of the transverse colon and practically the entire omentum had herniated into the pericardial sac, the omentum being adherent to the pericardium and the lateral and posterior portions of the epicardium of the left ventricle. The

defect was about 12 cm. in length. High up in the left side of the chest a small adhesion could be visualized in the region of the upper lobe.

ature varied from 98.8°F. to 99.4°F., the pulse from 112 to 128 per minute and the respirations from 18 to 28 per minute. On the morning
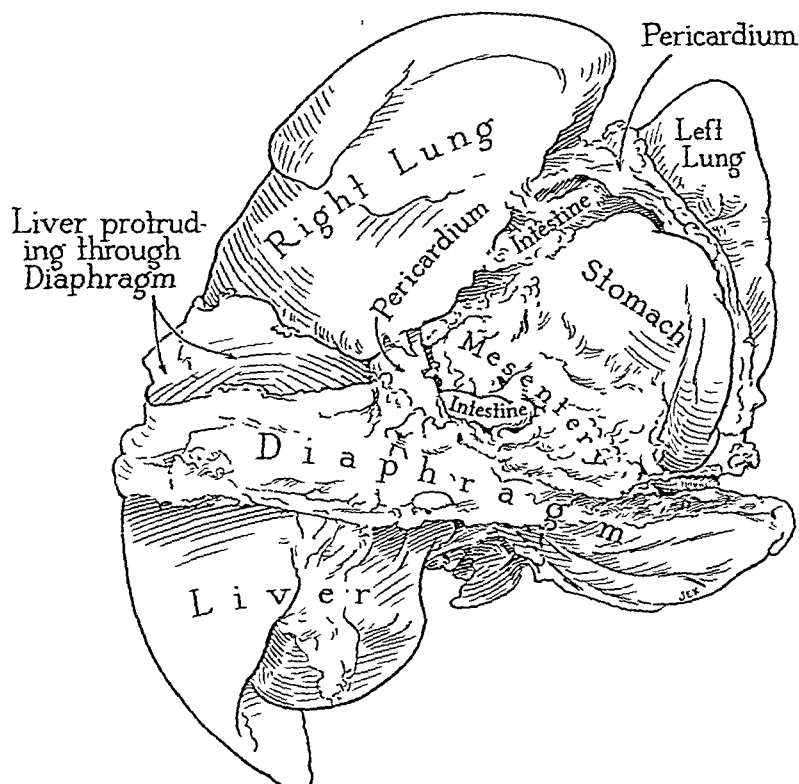
FIG. 3. Drawing to indicate structures as viewed at operation.

The left lung was collapsed. The adherent omentum, stomach and transverse colon were released from the margins of the defect and from the pericardium, epicardium and pleura and dropped into the abdominal cavity. An attempt was made to remove all remaining adherent tissue from the pericardial sac. The diaphragm was closed with interrupted silk sutures and the abdomen closed without drainage. Figure 3 illustrates condition found at operation.

Throughout the operation the patient's general condition was good. Prior to operation the blood pressure was 110 72. Ephedrine sulfate, 48 mg., was administered prior to the spinal anesthesia and 1 cc. of coramine was given after twenty-seven minutes of anesthesia, resulting in maintenance of the blood pressure between 74 46 and 142 80. The anesthesia was satisfactory throughout the operation and at the end the blood pressure was 102 68. Two hours after operation a transfusion of 500 cc. of citrated whole blood was given.

Convalescence was exceptionally smooth during the first forty-eight hours. The temper-

of February 19, however, there was considerable respiratory difficulty. Clinical and x-ray examinations showed that pneumothorax of the right side had resulted in compression of the right lung to about two-thirds normal size. Also a mild pneumothorax of the left side existed, with evidence of slight atelectasis throughout the left lung. Intrapleural pressure of the right side was found to be minus 2.5 to plus 2.5, and after aspiration of 925 cc. of air the pressure varied from minus 1.5 to minus 4.5. The aspiration resulted in marked improvement and the patient was taken from the oxygen tent which had been in use during respiratory embarrassment. The following morning an x-ray examination of the chest demonstrated an increase in the pericardial shadow and the presence of a small amount of fluid in the left pleural cavity. During the day of February 20, the pulse varied from 94 to 128 per minute and the respirations from 20 to 30 per minute. About 8:00 P.M. there was a radical change in the patient's condition, associated with paleness, rapid respiration and a weak thready pulse. After aspiration of 450 cc. of

air from the left pleural cavity, there was marked improvement and, with the aid of an oxygen tent, the patient was fairly comfortable.

hesions anteriorly it was found that there was a delicate line of adhesion to the anterior margin of a rupture of the diaphragm approximately

Dome of Liver protruding through rent in right arch of Diaphragm

x to x - repaired rent in left arch of Diaphragm and Pericardium through which Stomach and Intestines protruded
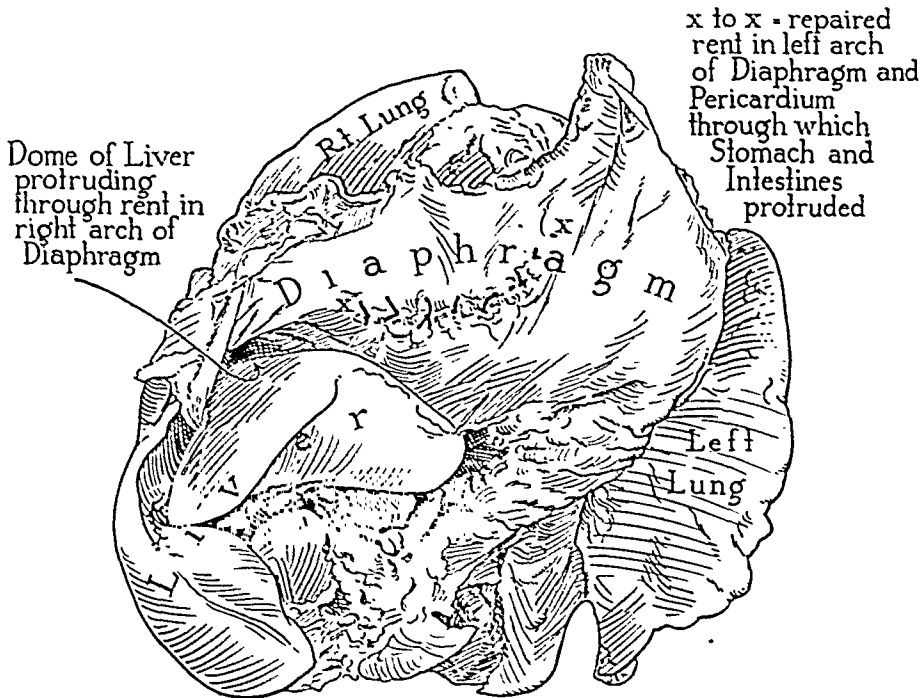
FIG. 4. Drawing to indicate structures as viewed at autopsy.

At 4:55 A.M., February 21, he failed rapidly, respirations failed at 5:05 A.M. and the heart ceased beating at 5:07.

Autopsy report (by Colonel G. R. Callender), disclosed a small pocket of grumous material beneath the operative wound, completely walled off by adherent transverse colon. The pericardial sac was laxly filled with bloody fluid. There was a mass of omentum approximately 8 cm. from above downward, 3 cm. from before backward and 1 cm. thick, adherent to the right lateral wall within the pericardium, and a similar mass, somewhat larger, on the left wall at the apex. Sutures were tied around the lower extremity of these two masses. The heart was adherent by dense fibrous adhesions just posterior to the suture line, the adhesions covering an area approximately 12 cm. in diameter, of the lateral and posterior epicardium. Firm fibrin covered the rest of the epicardium which was blood stained and rather fatty.

Both lungs were collapsed and both cavities contained air and about 300 cc. of bloody fluid each. There was one delicate fibrous adhesion from the lateral surface of the upper lobe to the anterior chest wall on the left. The right lung appeared adherent over the dome of the diaphragm, but on separating these ad-

15 cm. in diameter. Posteriorly the base of the right lung was adherent to the dome of the liver which projected through the diaphragm and was adherent to it except where the lung adhered to the diaphragm anteriorly. From the medial point of the anterior pulmonary diaphragmatic adhesions to the right margin of the pericardium, was a space free from any adhesion, making an opening between the pleural and peritoneal cavities. The projecting mass of liver had been compressed by the margins of the opening in the diaphragm so that it was partially separated by a fissure from the rest of the right lobe. The right lung was less atelectatic than the left. Figure 4 illustrates the condition found at autopsy.

The stomach was closely adherent for a distance of 10 cm. in the transverse portion of the greater curvature to the transverse colon between the two masses of omentum. These two structures showed points of separation of adhesions and apparently were the portions of stomach and colon found in the pericardial cavity. The rest of the gastrointestinal tract appeared essentially normal.

The liver pulp was somewhat yellowish and opaque. The gallbladder was distended with dark bile and the bile ducts appeared normal.

The spleen, weighing 160 Gm., showed marked acute passive congestion.

The final diagnosis was: bilateral, severe, traumatic diaphragmatic hernia, involving the pericardial sac and pleural cavity on the left with herniation of the transverse colon, omentum and lower half of the stomach, and involving the pleural cavity on the right with herniation of the dome of the liver; hemopneumothorax, bilateral; and hemopericardium, moderate, secondary to operation.

DISCUSSION

One of the most interesting features of this case is the presence of bilateral diaphragmatic lacerations in a man who lived for four years and ten months after injury, in whom a definite diagnosis of left diaphragmatic hernia was made prior to operation but in whom the presence of defect in the right side was unsuspected. At the time the patient developed collapse of the right lung after operation, it was suspected that the laceration had extended through the interthoracic septum. Though the pressure on the herniated portion of the liver had resulted in a deep sulcus, there was no other evidence of ill effect from the hernia of the right side. The introduction of air into the right pleural space at operation upon opening the abdomen caused collapse of the right lung. It is believed that recovery from operation would have resulted had this additional complication not occurred.

SUMMARY

A case of bilateral traumatic hernia of the diaphragm is presented with operative and autopsy findings, in which herniation of the stomach, omentum, and transverse colon occurred into the pericardial cavity on the left side through a defect of approximately 12 cm. and in which herniation of the dome of the liver occurred into the pleural cavity on the right side through a defect approximately 15 cm. in diameter.

TREATMENT OF FRACTURES OF THE SHAFT OF THE FEMUR BY DOUBLE WIRE TRACTION

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THE use of skeletal traction in the treatment of fractures of the femur has come into general use since the first World War. Calipers or ice tongs which were first used were succeeded by Steinmann pins and since Kirschner introduced his wire in 1923, it has become the most popular method. The Kirschner wire is easily drilled through the bone and the number of cases of bone infection produced is definitely less than when the former methods were in vogue.

Since 1935, the routine method of handling fractures of the shaft of the femur on the author's service at The Charleston General Hospital has been to insert a Kirschner wire through the distal fragment above the knee and apply traction through the bow, with the leg held in a Thomas splint and Pearson attachment. It was found that in many cases upward bowing of the distal fragment persisted in spite of manipulation, change of angle at the knee and reduction of weight. Open reduction was done in these cases until early in 1939, when it was conceived that if a second wire were placed through the proximal end of the distal fragment and traction made in a downward direction, toward the bed, reduction would be accomplished. Similarly in cases in which the distal fragment remains displaced posteriorly, traction on a second wire in an upward direction would produce the necessary correction. This method has been used to date in six cases with entirely satisfactory results.

A reasonably complete review of the available American and English literature reveals that no one has described this method before. In the latest edition of his book on fractures, Scudder mentions that H. E. Santee applied calipers to the condyles of the femur pulling upward toward the ceiling, with another pair of calipers pulling longitudinally from the head of the tibia in cases of persistent posterior displacement of the distal fragment.

CASE REPORTS

CASE 1. P. F., a white male, age thirty-five years, suffered a serrated fracture of the middle third of the shaft of the right femur and fractures of the five to the eight ribs on the right, in a fall of slate while at work in a coal mine on March 6, 1939. The following day, a Kirschner wire was inserted through the distal fragment and the leg placed in a Thomas splint with a Pearson attachment. Roentgenograms revealed persistent anterior bowing of the distal fragment which was not corrected by straightening the knee or using a pressure pad.

On March 14, 1939, under sodium pentothal anesthesia, the fracture was manipulated but no improvement was noted by fluoroscopic examination. Immediately, a second Kirschner wire was inserted through the proximal end of the distal fragment and twenty pounds of weight were tied to the bow with the pull toward the bed. This produced bowing in the opposite direction, but when some of the weight was removed it caused loss of contact of the fragments. Therefore, a slight degree of posterior bowing was accepted. On June 16, 1939, three months after the accident, the bows and wires were removed and a walking caliper brace applied. The patient left the Hospital on June 29, 1939, 115 days after the accident. Good union of the fracture resulted, but because of the long period of immobilization, the knee would never flex beyond 120 degrees and on May 6, 1940, a Bennett quadriceps lengthening operation was done. When last examined on August 19, 1940, he had active extension to 165 degrees. The leg was strong and he walked without support. No infection developed around the wires, the legs were the same length

and the posterior bowing of the femur was not visible in this case.*

CASE II. J. A. R., a white male, age thirty-

FIG. 1.
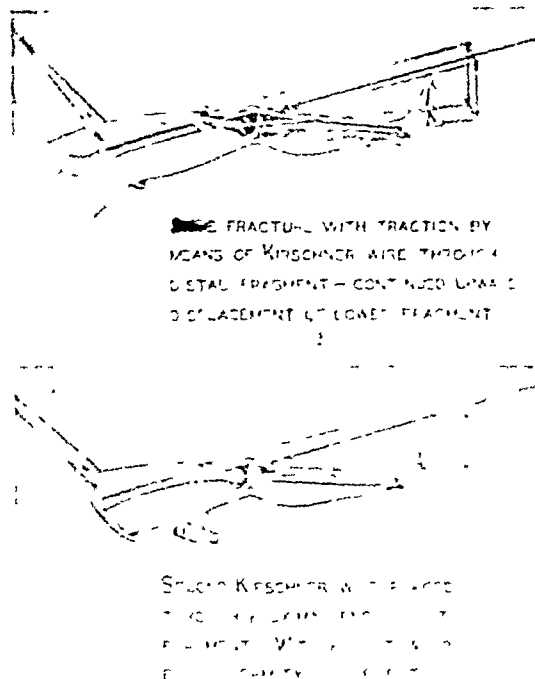
nine years, suffered a transverse fracture of the middle third of the shaft of the right femur on March 29, 1939, when he was struck by a timber while at work in a coal mine. It was treated in the usual manner by a Kirschner wire through the distal fragment. Fairly good position resulted, there being slight anterior bowing and lateral deviation of the distal fragment. Union apparently was progressing satisfactorily and weekly roentgenograms showed good position until the latter part of May when it was noted that further lateral deviation of the distal fragment was occurring. The rope which had been tied to the center of the bow was shifted to the medial side in an attempt to correct this. This produced still further anterior bowing of the fracture site. Straightening the knee, pressure pads and manipulation failed to correct the deformity. (Fig. 1.) On June 2, 1939, under local anesthesia, a second wire was drilled through the proximal end of the distal fragment and ten pounds of weight were added. This pulled down the displaced fragment into practically perfect position

* This patient when last examined on April 3, 1941, had active flexion to 70 degrees.

(Fig. 2) and solid union resulted. The patient left the hospital with a brace on July 7, 1939, 100 days after the accident. His recovery

FIG. 3.
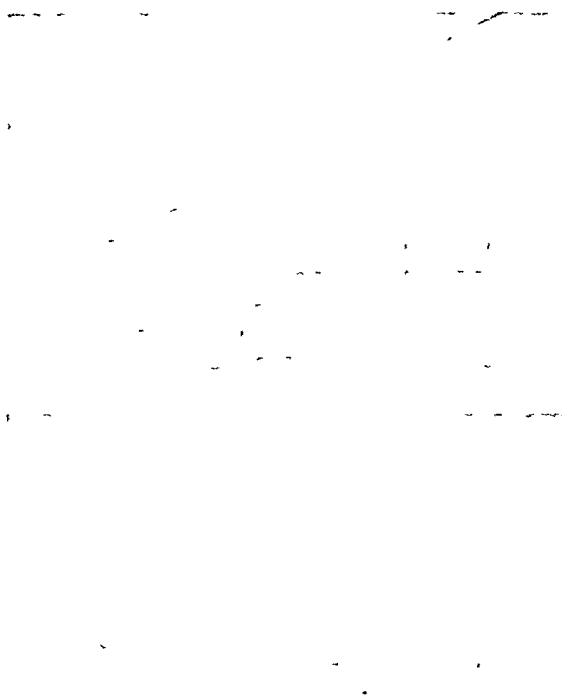
FIG. 4.

was rapid and he returned to work on March 12, 1940, eleven and one-half months after the accident. At this time, his legs were of the same length and his knee flexed to 80 degrees. No infection developed around the wires.

CASE III. C. M., a white male, age twenty-six years, suffered a severely comminuted fracture of the shaft of the left femur and dislocation of the right hip with a fracture of the right acetabulum in a fall of slate while working in a coal mine on August 1, 1939. Under ether anesthesia, the dislocation of the right hip was reduced and Kirschner wires placed through the distal ends of both femurs and the left placed in Thomas splints with Pearson attachments. Persistent anterior bowing of the distal fragment of the left femur resulted and on August 10, 1939, a second wire was inserted through the proximal end of the distal fragment. This pulled the fragment into line very well. The patient left the hospital wearing a caliper brace on October 28, 1939, eighty-eight days after the injury.

The left femur went on to complete healing but his progress has been impeded by the increasing stiffness of the right hip due to the

while at work in a coal mine. He was treated in the usual manner but anterior bowing of the distal fragment persisted (Fig. 3), and on
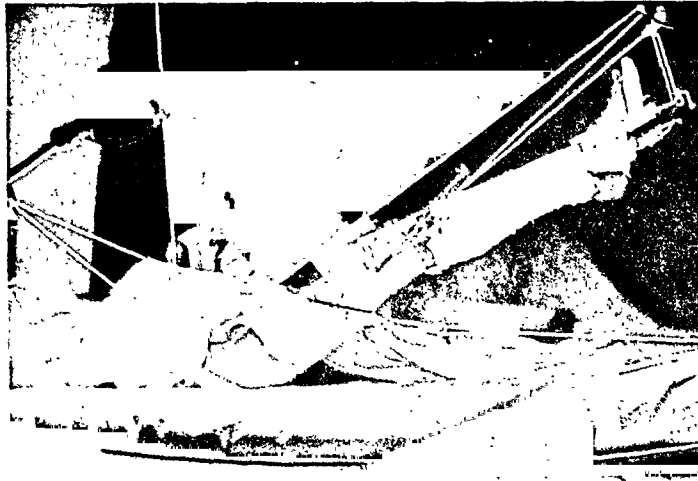
Fig. 5. Showing fracture of upper third of femur treated by two wire traction.

acetabular fracture. When last seen on August 19, 1940, both the left knee and hip showed active flexion to 90 degrees. His chief difficulty at that time was stiffness of the right hip due to the acetabular fracture. No infection developed about the wires in this case. This man of course is still unable to work.*

CASE IV. R. W., a white male, age twenty-five, suffered a transverse fracture of the middle third of the left femur on August 8, 1939, in a fall of slate in a coal mine. He was treated in the usual manner but anterior bowing of the distal fragment persisted. The second wire inserted on August 16, 1939, was too near the proximal end of the fragment and pulled out, so a third wire was inserted on August 23, 1939. This effected good position of the fragments and the patient left the hospital wearing a brace on November 2, 1939, eighty-six days after the accident. Slight infection developed around the wire holes in this case. Union resulted and the patient returned to work on April 8, 1940, eight months after his accident. When last examined on July 13, 1940, the wounds were healed and he was working regularly as a mine foreman.

CASE V. F. L., a white male, age twenty-two years, suffered a serrated fracture of the upper third of the right femur on September 25, 1939, when he was run over by a mine car

September 30, 1939, a second wire was inserted through the proximal end of the distal fragment. Because the fracture was so high, it was impracticable to tie weights to the bow as they would rest on the bed. Therefore, a rope was tied to the bow and traction was made by a pulley attached to the lower end of the bed just above the mattress. (Figs. 4 and 5.) This effected a very good result and the patient left the hospital on November 29, 1939, sixty-five days after his accident.

Some drainage of pus has persisted from the medial side of the upper wire hole in this case. Because of persistent drainage and the presence of a sequestrum as shown by x-ray, a sequestrectomy was done on July 24, 1940. He was last seen on August 5, 1940, when there was only very slight drainage from the wound. The legs were of the same length and he was certified as being ready to return to his regular work.

CASE VI. J. I., a white male, age fifty-nine years, suffered a comminuted fracture of the distal end of the left femur on June 24, 1940, when his leg was struck by a piece of coal. Longitudinal traction was made by a Kirschner wire through the proximal end of the tibia the same day. Roentgenograms afterward showed persistent posterior displacement of the distal fragment. On July 3, 1940, under local anesthesia, a second wire was placed through the proximal end of the distal fragment and pull made vertically upward with ten pounds of weight. Following this, roent-

* When last examined on February 3, 1941, the left hip flexed to 90 degrees and the knee flexed to 70 degrees. He still had some stiffness of the right hip but went to work a few days afterward.

genograms showed perfect replacement of this fragment. Healing took place satisfactorily and on August 19, 1940, a double spica cast was applied which he is still wearing.*

In the literature, no mention is made of persistent anterior displacement of the distal fragment. On the contrary, the common deformity recorded is persistent posterior displacement of the distal fragment which is thought to be due to the pull of the gastrocnemius muscle. The reason for the anterior displacement of the distal fragments in our first five cases is not clear. In some of the roentgenograms overpull is shown, but reducing the weight did not correct the deformity in any case. It might be thought that if the original Kirschner wire was placed too far anteriorly, such displacement might occur. The roentgenograms were carefully checked with this in mind. Two wires were exactly in the center of the shaft, two were slightly posterior to the center and one was slightly anterior. So, this could not be the factor. Excessive knee flexion might be blamed but in each case the knee was fully extended without help in correcting the displacement.

I personally treated twenty patients with fractures of the shaft of the femur in the year 1939. Thirteen were adults and seven children. In three cases, Russell traction was used; two patients were adults and one a child. All of the authors writing about Russell traction stress the fact that it is useless in fractures of the lower third of the femur. Our experience with it is not great

* Good union of the fracture resulted and when last seen on April 5, 1941, he had knee flexion to 90 degrees and was making good progress toward complete recovery.

but its field does not interfere with that covered by the two-wire traction method.

The two-wire traction method may be used equally well in fractures in which the distal fragment remains persistently posterior. The pull in these cases is made vertically upward, and accurate reposition of the fragments is obtained as is shown in Case VI.

In hospitals in large cities and centers where operative technic and assistants are of the best, there does not exist the urgent need for nonoperative methods of treatment of fractures. But in smaller cities and towns where it is extremely difficult to get well trained assistants and nurses, infection following bone operations is common, and any method designed to avoid open operation should be encouraged. I regret our two cases of infection of wire holes. One has cleared up but the other still drains slightly. With greater care this can be avoided.

CONCLUSIONS

A method is presented in which two Kirschner wires are used for the correction of fractures of the shaft of the femur with persistent anterior or posterior bowing of the distal fragment.*

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* Since the writing of the paper two more patients have been treated by this method. In addition to the two wires previously used, however, a third wire was used in each of these cases. Pull ventrally was made on the distal end of the proximal fragment and pull dorsally was made on the proximal end of the distal fragment in each case. The results have been good.

CHRONIC ULCERATIVE COLITIS WITH PSYCHOSIS*

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THE association of chronic ulcerative colitis with mental abnormalities has received considerable attention in the recent literature. Brown, Preu and Sullivan[1] are of the opinion that patients with the disease are of a personality type characterized by lability and a tendency to surrender in the face of difficulties. Wittkower[2] in his study of forty unselected cases found that thirty-seven had psychological abnormalities or disorders. No important etiologic relation has been established between mental disease and chronic ulcerative colitis although it has been suggested that exacerbations of the colitis may follow psychic disturbances. There can be no doubt, however, that the distressing situation of patients with severe ulcerative colitis offers justifiable cause for mental depression. Whether true psychosis is more common in the patient with colitis we do not know.

In the case herewith reported, major psychosis developed in a patient with intractable ulcerative colitis and was relieved after surgical removal of the colon.

CASE REPORT

A married woman, age twenty-seven years, with severe ulcerative colitis of one year's duration, was seen in consultation by one of us (L. W. G.) because she had developed serious mental symptoms. The disease had begun about eight weeks after delivery of a normal child. The delivery was said to have been difficult and convulsions were noted at the time. Several postpartum hemorrhages had occurred. Marked bloody diarrhea with anemia and wasting ensued. A rectovaginal fistula developed four months after the beginning of colitis and an attempted repair was unsuccessful. Her condition became worse and eight months after the disease had begun a tangential ileostomy had been performed elsewhere. After ileostomy some improvement was noted but bleeding persisted and secondary anemia was controlled by blood transfusions, twenty-four of which had been given. Soon after the operation of ileostomy the patient first demonstrated mental symptoms in the form of auditory and visual hallucinations. Delusions were present but at times she seemed to have insight.

The patient came under our observation in August, 1938. At the time of admission to the Albany Hospital she was in a catatonic state. Ulcerative colitis had been present one year. She exhibited cerea flexibilitas and responded to no normal stimuli. A psychiatric consultant made the diagnosis of catatonic type of schizophrenia.

Physical Examination. The patient was emaciated and there was marked pallor. A rectovaginal communication which discharged blood and pus was found. The tangential ileostomy was functioning well. Edema of both extremities was noted. The patient's temperature varied from normal to 100°F. and her pulse was from 100 to 120 bears per minute.

Laboratory Findings. Proctoscopic examination revealed advanced ulcerative colitis with marked bowel contraction and secondary polyposis. Roentgenograms after barium enema showed typical advanced ulcerative colitis involving the entire colon. The stools were negative for parasites and ova. The red blood cells numbered 3,250,000 per cu. mm. and the value for hemoglobin was 45 per cent Sahli. The value for serum proteins was low (4.6 mg. per 100 cc. of blood).

Surgical treatment was undertaken and after preliminary transfusions a terminal type of ileostomy was made to replace the existing tangential one. The operation was performed under cyclopropane anesthesia. Immediately following this operation there was a period of mental clarity followed by regression during convalescence. The mental state, however, never returned to its former severity and there was slight immediate improvement. Stupor was not so profound and the patient seemed to understand at times. Progressive improvement in the mental state, however, did not follow.

Bleeding from the colon and persistent anemia continued and four months after the

establishment of the new ileostomy the red blood cells numbered 2,450,000 and the value for hemoglobin was 55 per cent. Colectomy

euphoria, frequently seen in the later stages of recovery from this psychosis is still present. Delusions and hallucinations have disappeared.

FIG. 1. Photograph of colon and terminal ileum removed at operation.

was then performed at this time through an incision slightly to the right of the midline, extending from above the symphysis pubis to a point half-way between the xyphoid process and the umbilicus. The colon was removed down to the region of the lower sigmoid above the superior hemorrhoidal artery. The end of the sigmoid was inverted with some difficulty. Drains were placed in both colonic gutters. Cyclopropane anesthesia was used. Figure 1 is a photograph of the specimen removed.

Steady improvement in health and in mental symptoms followed colectomy. There was only very slight loss of blood from the rectal stump. Further transfusions of blood became unnecessary. At the time of dismissal from the hospital the patient was walking about and seemed much improved. There was some apprehension and auditory hallucinations were still present, though to a less degree. Soon after returning to her home, all mental abnormalities were lost as far as the patient's family could tell. We have seen the patient on several occasions during the year since operation and have found her a normal, healthy woman, interested in her family and in life in general. She has gained fifty pounds and her relatives detect no return of the psychosis. The ileostomy dejecta have lost their fluid nature and give little trouble. The patient engages in normal activities.

Examination by a psychiatrist confirmed our opinion that the patient has an excellent remission from her mental disease. A slight

The association of serious psychosis in this patient with ulcerative colitis seemed to us to indicate radical treatment for the disease. A return to normal health with the relief of anaemia may have been a factor in bringing about mental improvement. What part anaesthesia had in alleviation of the psychosis we cannot say. In this case surgical interference during a psychotic episode did not make the mental state worse at any time. Relief of the physical ailment was attended by rehabilitation of the individual to a useful life.

SUMMARY

The manuscript includes a report of the case history of a patient with chronic ulcerative colitis in whom schizophrenia, catatonic type, developed. Psychosis disappeared and mental health was restored with improvement in the patient's condition after a two-stage operation in which the diseased colon was removed.

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OBSTRUCTING CHRONIC CICATRICIAL ENTERITIS TREATED WITH SIMPLE LATERAL ANASTOMOSIS*

TEN YEAR FOLLOW-UP

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CONSIDERABLE data are now available which point to the fact that regional ileitis is increasing. The marked increase in the number of cases now seen cannot be wholly explained by the fact that the entity is better known and the profession more alert to its diagnosis. Pemberton of the Mayo Clinic in a personal communication states: "In December, 1936, I reported all the cases of regional enteritis seen at the Clinic in the fifteen year period 1922 to 1936 inclusive. There were thirty-nine cases, and at that time I attributed the increased incidence in recent years to an increased alertness on the part of the clinician and the roentgenologist in recognizing the disease. However, in the past thirty months we have seen sixty-eight cases, that is, there have been almost twice as many cases in the last three years as in the prior fifteen years. I now feel very definitely that the disease is on the increase."

Although Braun and Le Denty, in 1909, and Wilensky and Moschowitz, in 1923, reported important data, it was not until 1932 that Crohn, Ginsberg and Oppenheimer definitely established the entity of regional ileitis. Observations by Bargen, Brown and Weber showed that the lesion was not always confined to the terminal ileum and also suggested the term, "regional ileitis." The confusion that has existed regarding the disease is well expressed by the various stages that evolved in naming this clinical entity as, first, terminal ileitis, then regional ileitis, this supplanted by regional enteritis and now more commonly recognized as chronic cicatricial enteritis.

Dixon, in an analysis of a series of sixty-nine cases, was lead to the inevitable conclusion that the treatment of choice is radical removal of the involved tissue. Mixter in a very comprehensive survey of 363 cases collected from questionnaires sent to twenty-seven surgeons came to the conclusion that "radical surgical resection in one or more stages should be instituted." Jackson commenting upon proper surgical treatment states that it is still unsettled until late results of cases in which patients have been operated upon have been studied. Woolsey states that the treatment is essentially surgical, with conservatism as to resection. Cutler's point of view is definitely conservative.

Although the etiology is still not known, enough time has elapsed to evaluate the current modes of treatment and to draw some conclusions regarding them. In the main, two types of therapy have been used, medical and surgical; the former is of little value in the definitely obstructed type of disease and at this stage the vast majority require surgical interference. The commonly accepted surgical procedure is a resection of the obstructed area and a determination to go well beyond this area to get healthy tissue. In evaluating the end results of such resections, one is confronted with a very vital question: Does this radical procedure with its added risk give justifiable good results? Unfortunately, in spite of the theoretical soundness of this plan, recurrences of the disease are still reported. The result of the questionnaire sent out by Mixter showed the surgical mortality to be 14 per cent in a series of 278 cases in which the patients had been

subjected to major surgical procedures, mostly radical resections. In an analysis of other material collected by the same author

The patient, T. K., age thirty-seven, Italian extraction, was seen at the Grace Clinic on

Fig. 1.   Fig. 2.

Fig. 1. Illustration showing patient before operation.
Fig. 2. Illustration showing patient after operation.

the surgical mortality was 20 per cent. From a brief analysis of collected material to date, two fundamentals stand out: (1) radical resection is still associated with many recurrences and, (2) reported mortality is between 14 and 20 per cent.

In an effort to add a small piece of evidence to the accumulated data on this interesting disease, the case of the following patient treated by simple ileocolostomy is reported, with a ten year follow-up:

February 24, 1930, at which time she complained chiefly of diarrhea and a nauseated feeling, symptoms which she had first noticed in the autumn of 1928. At that time she visited a local doctor. Because she did not seem to get relief from his prescribed treatment and because abdominal pains became more distressing and frequent, she visited another doctor in the early part of 1929. A diagnosis of chronic appendicitis was made and the patient underwent an appendicectomy. However, less than six months postoperatively the abdominal

pains recurred with alarming intensity. After being treated for another six months with periodic relief, she visited the Clinic. At this time, the patient stated that from 1928 until the present time, 1930, she had never had the slightest trace of abnormal temperature, appetite had been good during the intervals when pain was not present; but immediately after eating the pains would become acute, all nourishment would be vomited and at times the vomitus was almost fecal in character. During severe attacks, the muscular contractions of the intestine were plainly visible, "squirming and turning like a tortured snake beneath the skin." During the past six months hypodermics of codeine and morphine had been used to relieve the severe abdominal pain; however, these hypodermics had become ineffectual just prior to coming to the Clinic. Frequent high colonic irrigations were used unsuccessfully. During the past year the patient had experienced considerable loss of weight, from 115 pounds to fifty-nine pounds.

Physical examinations revealed an emaciated, dehydrated, cachectic female weighing fifty-nine pounds, with marked distention of the abdomen, apparently small bowel obstruction. The blood count showed: hemoglobin 61 per cent; red blood cells, 4,150,000; polys 55 per cent; lymphocytes 44 per cent; eosinophiles 1 per cent. A working diagnosis of chronic ulcerative colitis was made; however, all studies done to confirm this diagnosis were negative.

X-ray of the stomach showed: "7 hours after barium meal, head of meal is in terminal ileum which is displaced to the left, and dilated. This points to an obstructive lesion in the terminal ileum, most likely due to adhesions. Twenty-four hour film shows opaque meal in colon; cecum is not greatly deformed. There is still some barium in terminal ileum and dilation of ileum. This points to a non tbc. partial obstruction of terminal ileum."

On April 9, 1930, a side-to-side ileocolostomy was done to relieve the obstruction in the ileum. Exploration of a mass which was continuous with the dilated ileum showed it to be an agglutinated assemblage of fibrotic and stenosed bowel all matted down in the right lower quadrant of the abdominal cavity. The lumen of the ileum proximal to the obstruction was distended four or five times its normal diameter and markedly hypertrophied. Although a biopsy specimen was not removed at the time of operation, we believe that the classical history for chronic cicatricial enteritis, the x-ray confirmation of obstruction and the operative findings permit one to venture the diagnosis of probable chronic cicatricial enteritis.

The patient was last seen ten years postoperatively. She appears to be in perfect health, has no complaints, weighs 133 pounds and x-ray study was negative except for some irregularity in the area of the cecum. The patient is carrying on the responsibility of a large household and seems in excellent physical condition. This patient now (April 3, 1941) is enjoying good health.

CONCLUSION

In view of the excellent result ten years after conservative measure of ileocolostomy, this case should be added to the accumulating evidence warranting an open mind toward conservative therapy in this type of disease.

CROSSED RENAL ECTOPIA

CASE REPORT

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ALTHOUGH not rare in its occurrence, crossed renal ectopia is definitely uncommon. To date, 161 cases have been reported, to which another is now added. The case presented is unusual because of the presence of a pneumococcus pyelitis and that negative cultures were obtained following administration of sulfapyridine. No such case can be found in the literature.

Beer and Hagman estimate the occurrence of crossed ectopia as one in 8,000 cases. Stuart and Lodge found it only once in 6,500 autopsies. The condition is more frequently seen in males; the right kidney is more frequently displaced than the left.

CASE REPORT

J. S., case #59183, a white male, aged twenty, was admitted to the Opthalmologic Service at Temple University Hospital, suffering with a painful inflammation of one eye for a period of three months. He gave a history of having had a pyelitis at eight years of age, with recurrences to the present date. Urinalysis revealed 2-4 leucocytes and 2-3 red cells a field.

Cystoscopy, April 24, 1939, revealed considerable pus and débris floating in a rather distorted vesical cavity. The vesical mucous membrane was acutely inflamed. The right ureter was located not on the interureteric ridge but on the lateral wall of the vesical neck. This was catheterized and a specimen taken for culture. The left ureteric orifice could not be located. Indigo carmine was eliminated from the right ureter in three minutes; none was observed as coming from the left ureter.

Urine culture, April 26, 1939, of specimen taken from right ureter was reported as negative for tubercle bacillus but showed a definite growth of pneumococci, type 19, and Bacillus proteus.

Sulfapyridine, grains 15, was given four times a day. On May 6, 1939, urine culture was reported as showing Bacillus proteus and pneumococci.

A culture report four days later, was negative for Bacillus proteus and pneumococci. Subsequent repeated cultures have revealed similar findings.

Summary of the Roentgen Findings on the Intravenous Pyelographic Studies, and Retrograde Pyelographic Findings. Preliminary films of the abdomen show a calculus in the upper half of the left kidney, measuring about ½ by 1 cm. The left kidney shadow is fairly well visualized and appears unusually large, the lower pole reaching to within 1 cm. of the left iliac crest. There is no evidence of a kidney shadow on the right side. There is evidence of congenital maldevelopment in the lumbosacral region. This appears as a partial lumbarization of the first sacral segment with deformity. The laminae of the first sacral segment are not fused posteriorly and the lumbosacral zygapophysial joints are situated at different levels on the right and left sides, causing a tilting of the fifth lumbar vertebra toward the left and a compensatory mild scoliosis of the lumbar spine.

Films made five and fifteen minutes after the intravenous injection of 20 cc. of diodrast solution show a well filled system of renal calyces on the left side, connected to a small pelvis and single ureter. The superior and inferior groups of calyces appear to be separated more than usual, the upper limit of the most superior calyx lying 10 cm. above the lower limit of the most inferior. In addition, the system of calyces appears somewhat crowded from side to side, and shows slight lateral displacement together with 90 degrees abnormal rotation, diminutive pelvis and the ureter pointing anteriorly.

Films made forty-five minutes after injection (Fig. 1), following removal of the compression block, show some addition and irregular dye collections mesial to the pre-

516

viously described system. These collections give no semblance of normal calyces or of a normal kidney pelvis and there is no evidence

one ureter passing down to enter the bladder on the left side; the other, crossing to the right side to enter the bladder on the right side. I

FIG. 1. Forty-five minutes after diodrast showing irregular dye collections on left side only; no evidence of kidney shadow on right.
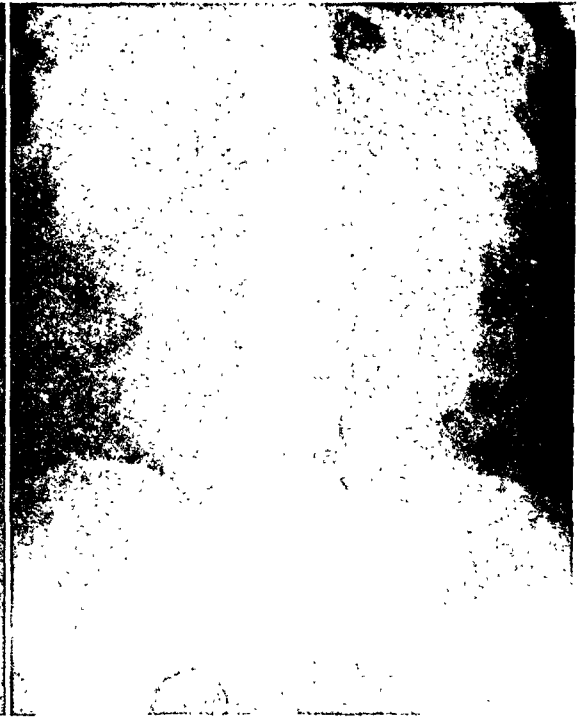
FIG. 2. Catheter introduced through right ureteric orifice showing its course diagonally across to the left renal area.

of their having a ureteric connection. At this time, the lower end of the left ureter can be visualized entering the bladder, and the bladder contour is also well seen. The bladder is asymmetrical, being situated somewhat to the right with its right half situated at a higher level than its left half. None of these studies give any evidence of dye on the right side.

Retrograde pyelographic studies made on June 15, 1939 (Fig. 2), show the opaque catheter passing up the right ureter and crossing to the left side at the level of the fourth lumbar interspace. The opaque solution injected outlines a very irregular renal pelvis and system of calyces on the left side which correspond to the irregular dye collection noted on the films made forty-five minutes following the intravenous injection.

By correlating the intravenous pyelographic findings with the retrograde findings, it becomes evident that two renal units are present on the left side, each with its own ureter, the

understand that only the right ureteric orifice can be located cystoscopically and it is interesting to note that by the intravenous method only the left urinary tract was well defined, because of poor function on the part of the other urinary tract in concentrating the dye.

The patient was discharged on May 20, 1939. The inflammation of the eye had entirely cleared. The pyuria had disappeared and he had no further complaints.

CONCLUSION

Another case of crossed renal ectopia is herewith reported. The diagnosis was established by comparison with retrograde and excretory urography. Physical signs and symptoms in the case presented were negative with the exception of pyuria. The case presented was complicated by a pneumococcis pyelitis. Successful treatment with sulfapyridine is hereby recorded.

New Instruments

WEIGHTED NASAL GASTRODUODENAL TUBE

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TOWARD the end of the nineteenth century, clinicians began to study the possibility of exploring the duodenal contents by way of intubation. Two attempts were made at that time in this direction, one by Hemmeter[1] in 1895 and one by Kuhn[2] in 1898. Both attempts proved impractical as their instruments were crudely constructed.

After experimenting a number of years on various tubes and buckets, Max Einhorn[3] in 1909 developed his duodenal bucket which consisted of a gold-plated, perforated metal capsule tied at the end of a thin rubber tube. This was a truly significant advancement in gastroenterology. Since that time, American gastroenterologists have developed tubes with various types of tips, which I have fully described in a recent article.[4] However, most of these tips were all alike in principle, differing only in their size, shape, weight and number of perforations and none added any decided advantages to Max Einhorn's original tube.

In 1937, I described my new bucketless lead-weighted tube[4] (Fig. 1A) which was a radical departure from previous tubes, in that the bucket was entirely eliminated, and its terminal end encases an elongated drop-shaped lead sinker. (Fig. 1A insert.)

It is of interest to indicate here that the above tubes were introduced by mouth and the element of weight was considered an important factor for the purpose of maintaining the tube along the stomach pathway and accelerating its entrance into the duodenum.

Levin[5] in 1921 advocated the use of a tipless gastroduodenal catheter which he preferred to introduce through the nose. It had a velvet edge at its terminal end exactly like a urethral catheter, No. 14 French in diameter, and had four side openings, oval in shape, at its terminal two inches. While the tube proved highly useful, its disadvantage lay in the fact that the lack of a weighted end resulted in inadequate propulsion into the duodenum.

To overcome this defect, Wilkins[6] in 1928 proposed a nasal mercury-weighted tube which had a mercury holding compartment four and one-half inches long and three-sixteenths inch in diameter at its terminal end with the openings situated above this compartment.

In 1933, Wangensteen[7] proposed his nasal gastroduodenal tube which has the terminal four inches impregnated with lead thereby making it considerably heavier than the Levin tube. This tube contained nine openings in its terminal ten inches and its chief disadvantage lay in the fact that it failed to yield siphonage when the upper openings were above the fluid level.

Recently, I developed a double channel simultaneous gastroduodenal aspirator,[8] the tip of which is lead impregnated for the terminal two and one-half inches. It occurred to me that by substituting the lead encased sinker of the oral tube (Fig. 1A) with a lead impregnated solid rubber tip, I would have an efficient nasal single channel gastrointestinal tube.

The tube (Fig. 1C) is fifty inches in length, No. 14 and 16 French in diameter, semisoft in consistency, flexible and of good resiliency and is made of cacoprene rubber. It terminates in a catheter-like tip which consists of solid lead impregnated rubber

one and three-fourths inches in length and is of the same diameter as the rest of the tube. Two openings slotted in appearance are

proper position along the stomach pathway and accelerates its entrance into the duodenum.
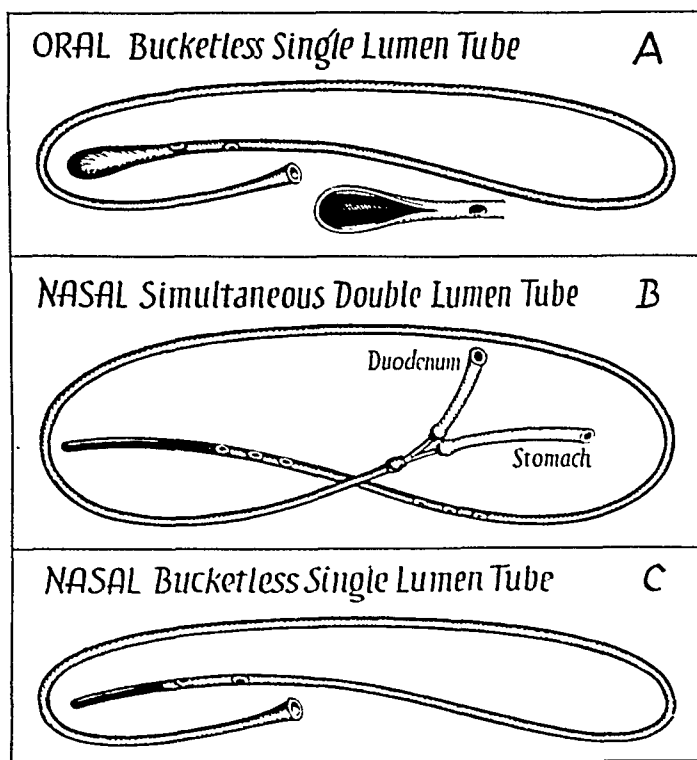
Fig. 1. Author's oral and nasal single and double lumen tubes.

situated just above the tip one inch apart on opposite sides of the tube. The diameter of the slots is smaller than the lumen of the tube thus preventing clogging of the tube by particles of food.

The markings are situated as follows: one-ring mark which represents the distance from the nares to the cardia is placed at nineteen inches; two-ring mark which represents the distance from the nares to the pylorus is placed at thirty inches; and the three-ring mark at thirty-five inches from the tip. It is understood that the physician's judgment should always determine the amount of tubing for each individual and that he should not rely solely on the markings on the tube.

ADVANTAGES

1. The one and three-fourths inch lead impregnated solid rubber, catheter-shaped tip at the terminal end facilitates the introduction and passage of the tube through the nares.

2. The weight of the lead impregnated tip facilitates the passage of the tube through the esophagus, maintains it in its

3. There is less possibility of the lower part of the tube regurgitating into the stomach as the weight of the lead impregnated solid rubber tip anchors the tube in the duodenum.

I wish to express my gratitude to Mr. L. T. Hilborn, president of Clay-Adams Co., for his kind co-operation in the development of the tube.

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A BENT BLADE SCALPEL

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FROM the earliest days of surgery, men have devised instruments to facilitate operative work. The knife or scalpel, as

FIG. 1. A 60 degree angular blade carrying a circumferential cutting edge.

it is called, has always been the most useful and important instrument in the hands of the physician, and various sizes and shapes of blades testify to the uses for which they were devised. In abdominal and gynecological surgery there are many operations that could be made essentially easier if the cutting edge of the knife blade were at a different angle than the commonly accepted straight blade. With this thought in mind, during the last year we have experimented considerably with bent blades. * Blades of various angles from 45 degrees to 60 degrees from the horizontal handle have been used. Blades with both right and left cutting edges have been tried out, but the

* Rudolph Beaver, Inc., Waltham, Massachusetts.

best results, in our hands, have been obtained with a 60 degree angular blade carrying a circumferential cutting edge.

(Fig. 1.) The uses to which this blade can be put are innumerable, and the operations in which we believe it serves its best purposes are the following:

Cholecystectomy—in dissecting the gall-bladder and severing the cystic duct; *sub-total hysterectomy*—in reflecting the bladder, separating the fundus from the cervix, and coring out the cervix; in *vaginal cervical amputations*, following either the Sturmdorf or Schroder methods; and in *trachelorrhaphy*.

We are of the opinion that any surgeon, after seeing this blade, would be instantly aware of its advantages in the operative field.

UROLOGY

IN THE

FEMALE

BY

HOUSTON S. EVERETT, M.D.

Associate in Gynecology, Johns Hopkins University; Gynecologist
in Charge of the Cystoscopic Clinic, Johns Hopkins Hospital

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UROLOGY IN THE FEMALE[*]

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I. INTRODUCTION

THROUGHOUT most of the nineteenth century efforts to devise some means of adequately examining the interior of the urinary tract engaged the attention of investigators among whom were several prominent gynecologists. Hunner[5] in his chapter on "Diseases of the Bladder and Urethra" in "Gynecology and Abdominal Surgery," by Kelly and Noble, has reviewed the history of this work. Among those whom he mentioned as having devised some type of cystoscope or endoscope applicable to the female were Ségales, of Paris, 1828, Desormeaux, 1852, G. Simon, of Rostock, 1875, Rutenberg, of Vienna, 1876, Grünfeld, of Vienna, 1877, and Skene, of Brooklyn 1878. The instruments devised by these men were of a tubular or conical type closed by a glass window on the vesical end to prevent the escape of water or air which was used to distend the bladder. All of them used water, but Ségales and Rutenberg also used air. Various methods of illumination were used including reflected light from a head-mirror, used by Grünfeld who was also the first to sound the ureters under sight, a metal sound being passed through the urethra beside the cystoscope. Simon had previously passed metal catheters into the ureters guided by palpation with the index finger, after having incised the meatus and dilated the urethra sufficiently to admit the finger into the bladder. Pawlik of Prague devised a more practical and less mutilating procedure of guiding a metal catheter into the ureter by means of vaginal palpation. Nitze in 1889 published his "Lehrbuche der Kystoskopie" in which he described his work, begun in 1886, which led to the development of the forerunner of all modern indirect cystoscopes, which make use of

[1]

the principles of a light within the viscus and a series of lenses to magnify and bring the field to be examined into view.

Howard A. Kelly early in his career recognized the great importance of diseases of the urinary tract as related to gynecology. The two opening paragraphs from his paper published in 1888 on "Palpation of the Ureters in the Female"[112] are so prophetic of subsequent lines of development that they are worthy of direct quotation:

"By palpation of the ureters the gynecologist has at his command a new and valuable adjuvant in the correct diagnosis of renal and bladder diseases and their sequelae, as well as the possibility of recognizing intrinsic diseases of the ureters hitherto only discovered on the postmortem table. Such is the specialization of specialties, that I have been asked by surgeons if the ureters are prone to disease of any sort or variety. It is but necessary to consult the works of Rayer, Cruveilhier, and others on renal diseases, and especially the plates of the former, to recognize at once the extent to which the ureters are often associated with the kidneys, participating in processes of inflammation, ulceration, and tuberculosis. Here invariably the ureteral disease is secondary, descending, and the condition of the ureters discovered by a vaginal examination may be the first clear point in determining the nature of the disease above, and the only possible means, short of operation, of determining on which side the disease exists. Again, inflammatory diseases of the bladder, particularly gonorrheal, often have a fatal tendency to travel upward, resulting in pyelitis and pyelonephritis. Here the affection of the ureter invariably precedes that of its pelvis and the kidney, and may at once put a careful observer on his guard as to possible consequences, even of an apparently mild inflammation. Calculus resting in the pelvis of the kidney or lodged in the ureter, occasions an inflammatory condition of the whole of the tract below, easily distinguished by palpation.

"When we recall the immense quantities of excrement discharged daily through these delicate tubes, from two organs absolutely essential to life, one or other of which may be diseased, or both in different degrees, and associate with this the anatomical relation of the pelvic portion of the ureter in the female, placing it within easy reach of the examining finger, we see at once the importance of a careful routine consideration of their condition and function in every case coming under observation. It is but necessary to bear in mind the cases of hydro-nephrosis which have been caused by pressure of uterine tumors, ovarian tumors, retroflexion, and even prolapsus uteri, and the constriction of parametric scars, caused also in one case by a retroperitoneal sarcoma observed by the writer, and to remember the possible effects of pressure by the gravid uterus, as well as the large number of cases of carcinoma uteri which die of uraemic coma, from involvement and obstruction of the ureters, not to cite cases in which

the ureters have been tied in enucleating the cancerous uterus per vaginam, as communicated to me by Dr. H. S. Coe, and observed by others, as well as cases in which a ureter has been cut in opening a pelvic abscess, to realize the clinical importance of ureteral pathology. I may also here mention the fatal results which have followed the neglect of Dr. Emmet's precaution, in the operation of vesico-vaginal fistula, of rolling out the edges and hunting for the ureteral orifices, a neglect which has in many instances resulted in death and in more in a failure in the operation. This brief statement of the important facts serves to show how extended a field is here open for the gynecologist, connecting him often with practical medicine, just as the abdominal surgeon of today closely links his work with that of the general surgeon. In fact, with a more careful study of bladder trouble, now the bête noir of gynecology, with a differentiation of bladder and ureteral diseases up to this time impossible, and with an association of a careful study of renal diseases as connected with or to be disassociated from the last, a new realm seems to be opening to the scientific gynecologist."

This paper as might be surmised from its title, although it referred to inspection of the ureteral orifices and their catheterization through a vaginal cystotomy wound as suggested by Emmet, and to the methods of catheterization used by Simon and Pawlik which have already been mentioned, was devoted largely to the technic of palpation of the ureters through the vagina and the knowledge to be gained therefrom. A man of Dr. Kelly's energy and ingenuity, however, was not to be satisfied long with the information that he could gain by palpation of the ureters alone, nor with the crude methods then available for ureteral catheterization. In 1893, he delivered an address before the Washington Obstetrical and Gynecological Society entitled "The Direct Examination of the Female Bladder with Elevated Pelvis—The Catheterization of the Ureters under Direct Inspection, with and without Elevation of the Pelvis."[113] In this the use of a simple open tubular speculum, through which the bladder could be distended with air by means of posture, was described. Most of the instruments and technic of what is known today as the "Kelly open air" method of cystoscopy were also described. Three positions were suggested for obtaining distention of the bladder by air; the dorsal position with hips elevated, the Sims position, and the knee chest position. The last named soon became recognized as superior to the others in most instances.

As an outgrowth of this pioneer work by Dr. Kelly, examination of the urinary tract and treatment of its diseases became an integral part of the work in his gynecologic department at the Johns Hopkins

Hospital. Gradually a female cystoscopic clinic for examination and treatment of both hospitalized and out-patients was established as a definite unit of the gynecologic service. Dr. Guy L. Hunner, who early in his career became especially interested in this phase of gynecologic practice, has been the guiding influence in this clinic to the present date. Through his careful and painstaking observations he has contributed much to the speciality of urology, not only as applied to gynecology, but to general urology as well. Many of his published contributions will be referred to later, but above them should be placed the example that he unceasingly has set before his understudies of untiring patience, careful attention to detail and faithful labor in the interest of his patients. As a result of the examples and teachings first of Kelly and later of Hunner, there have been trained and spread about this country a group of gynecologists who have come to look upon their specialty as one dealing with the genital and urinary tracts in the female. This is, it would seem, the only logical development of this specialty. These two systems of organs are so closely related anatomically and pathologically that it is impossible to examine and treat the one without a thorough knowledge of the other also. To emphasize this a direct quotation from Hunner[78] is to the point: "Can there be any more reason for demanding that the specialist in male genital diseases should be a first class female urologist than there would be in expecting a gynecologist to do justice to male patients suffering from urinary tract disorders? One rarely sees women patients with urological complaints in which there does not enter some question in gynecology. One cannot be a gynecologist and do his patients justice without constantly weighing the finer points in urology and having the facilities at hand to decide whether the patients' chief complaints arise in the genital or in the urinary tract."

In the following pages an attempt will be made to develop this thesis by dealing largely with structural and pathologic entities in the urinary tract which are peculiar to the female. In order to do this the following outline will be developed: (1) The anatomic relationships between the urinary and genital tracts will be briefly described. (2) Diseases of the urethra which differs strikingly in the female from the same organ in the male will be treated in full. (3) Conditions resulting from the traumas of parturition and from gynecologic therapy will be emphasized. (4) Disorders arising in the urinary tract resulting from lesions of the genitalia will be discussed. (5) Urinary

tract infections complicating pregnancy and the puerperium will be fully treated.

Such conditions as pyelitis and pyelonephritis not associated with
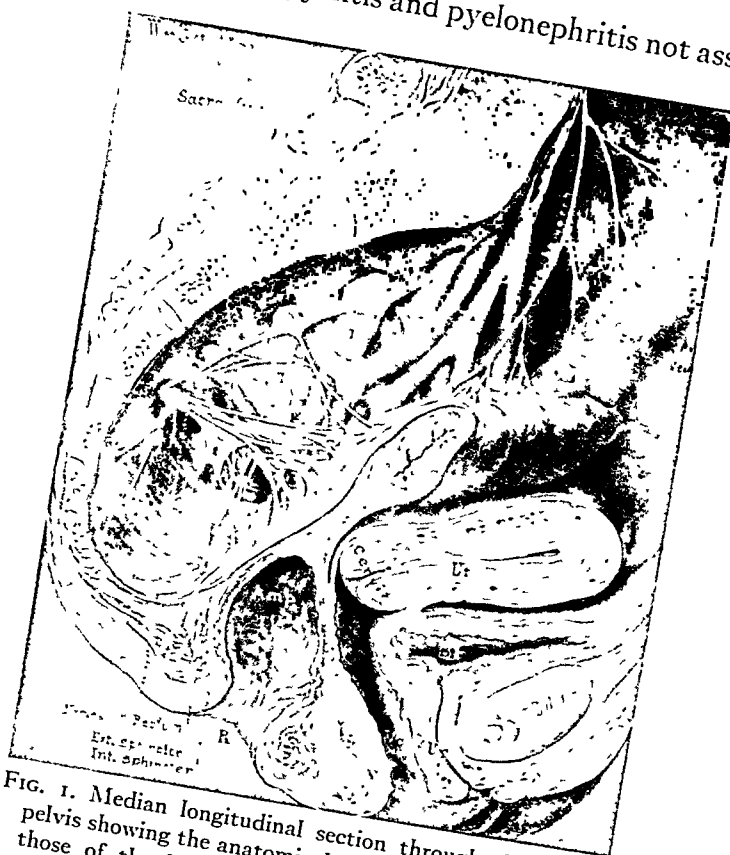
FIG. 1. Median longitudinal section through the female pelvis showing the anatomical relationships, particularly those of the bladder and urethra to the uterus and vagina. (From Kelly, Howard A. Operative Gynecology New York, 1898. D. Appleton & Co.)

pregnancy, urinary lithiasis, tuberculosis and neoplasms, which are common to both sexes will be touched upon sparingly, and then only to point out certain etiologic factors that may be peculiar to the female.

II. ANATOMY

No attempt will be made here to describe completely the anatomy of the urinary tract. Those desiring to review this subject may be referred to "Diseases of the Kidneys, Ureters, and Bladder," by Kelly and Burnam.[121] In order to stress the close relationship between the urinary organs and those of the genital tract, however, a brief

review of several important points will be set forth. The accompanying illustrations serve to bring out these points more vividly than can be done by description. Figure 1 shows a median longitudinal section through the female pelvis. From this illustration the close relationship between the urethra and bladder on the one hand and the vagina and uterus on the other can be readily seen. The urethrovesicovaginal septum is made up of mucosal, submucosal and muscular coats of the urethra and trigone and base of the bladder, and of the pubocervical fascia and vaginal mucosa. The pubocervical fascia, which is the anterior portion of the vaginal reflexion of the internal fascial covering of the levator ani muscle, extends from the inner surfaces of the pubic rami upward and posteriorly to be attached to and reflected downward on the anterior surface of the cervix. The strong lateral portions of this fascia are often called the pillars of the bladder. It is a thinning out of the central portion of this fascia, often together with a separation of it downward from the cervix, that results in the formation of a cystocele. When the thinning out extends anteriorly beneath the urethra, a urethrocele is formed and frequently the normal support of the urethral sphincters are lost and varying degrees of incontinence result.

Figure 2 shows the arrangement of the muscular coats of the bladder and urethra and the urethral sphincter mechanism.

Figure 3 shows the position of the kidneys, ureters and bladder with reference to the structures in the posterior abdomen and in the pelvis. From this illustration it can be seen readily how the ureters as they cross the pelvic brim are subject to compression by pelvic tumors or the pregnant uterus. The close proximity of the ureters to the ovarian vessels as they approach the ovaries in the infundibulopelvic ligaments is also apparent.

Figure 4 shows the relationships between the uterus and uterine vessels on the one hand and the bladder and lower ureters on the other.

III. THE URETHRA

During recent years it has been the frequent lament of several prominent urologists (W. E. Stevens, John R. Caulk, A. I. Folsom, and others) that the female urethra is a much neglected organ. It is indeed true that in most textbooks and systems the space allotted to diseases of this organ is relatively small as compared with that devoted to the male urethra and to other organs of the urinary tract.

FIG. 2. Musculature of the bladder and urethra. a, diagram showing direction and disposition of muscle bundles composing the voluntary sphincter of the urethra (sphincter urogenitalis); the uppermost bundles (1) surround the urethra, the terminal fibers passing in an upward direction in the vesicovaginal septum. Other fibers form a complete ring muscle (see also little Figure (1) below). The middle bundles (2) surround the urethra in front, passing over into the vagina and becoming inserted in its lateral musculature. The lowermost bundles (3) surround both the urethra and the vagina, terminating in the rectovaginal septum (see little Figure 3 below). The urogenital sphincter terminates at the junction of the external and middle portion of the urethra, the lowermost portion being embraced by the M. bulbo cavernosus with the erectile tissue of the bulbi vestibuli intervening. b, dissection of the muscle coats of the bladder and urethra. A little square has been cut in the outer longitudinal layer of the bladder and urethra, exposing the fibers of the middle circular coat. The voluntary sphincter of the urethra is shown in its entirety. A portion of the pelvic fascia and the triangular ligament is removed in order to expose the urethra. c, diagrammatic representation of the involuntary sphincter of the urethra, the M. sphincter trigonalis. As shown in the Figure, the fibers of this sphincter have their origin in the muscle bundles of the trigonum, the fibers passing obliquely downward and forward and surrounding the internal urethral orifice in an oblique direction. The lower circular fibers of the urethral sphincter are inserted in the lateral vaginal wall. The fibers of the inner longitudinal muscle coat of the lower urethra are relatively strong and taper as they end, only a few reaching as far as the bladder. d, injection of the erectile tissue of the urethral submucosa. (Figure and legend from Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)
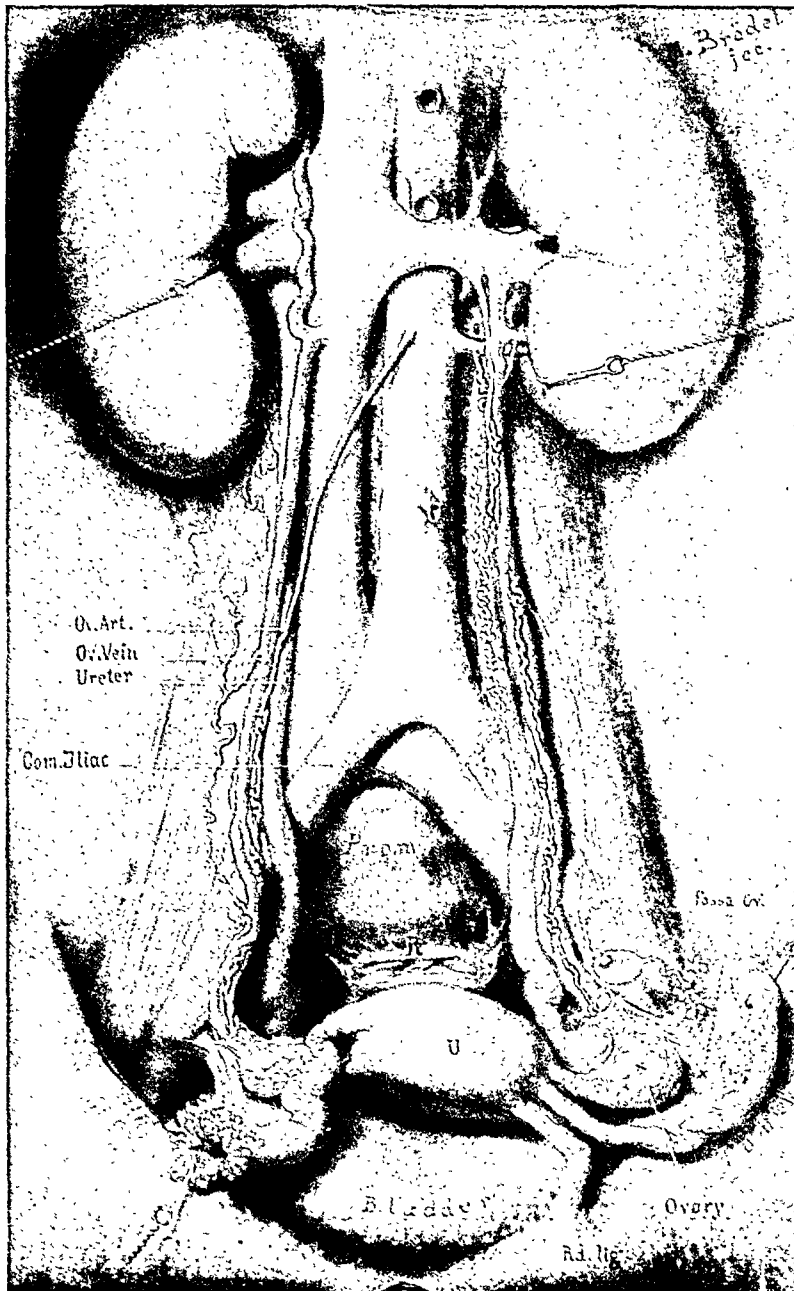
FIG. 3. Showing the relation of the kidneys and ureters to the ana-
tomical structures in the posterior abdomen and in the pelvis.
(From Kelly. Operative Gynecology. New York, 1898. D. Appleton
& Co.)

If one reviews the recent urologic literature, however, there are to be found quite a large number of contributions dealing with this subject. Among these contributions, however, are found so many and such

FIG. 4. Showing the anatomical relations of the bladder and left ureter to the cervix uteri and to the uterine vessels. (From Kelly. Operative Gynecology. New York, 1898. D. Appleton & Co.)

varied opinions as to what lesions are of most frequent occurrence and of chief importance, that confusion soon results unless the reader possesses a sound background of personal experience, in the light of which he can weigh these conflicting opinions. In the following pages devoted to the subject of the female urethra, an attempt will be made to review and analyze some of this literature in the light of experience derived from the urologic handling of female patients exclusively.

1. *Anatomy.* The female urethra is a tubular structure, the length of which is variously stated by different authors as being from 2.5 to 4 cm. My own measurements recently made on a series of

twenty women have disclosed lengths from 3 to 5.5 cm. with the majority being between 4 and 4.5 cm. and the average 4.1 cm. The normal adult urethra in most instances is capable of easy dilatation to a diameter of 9 or 10 mm., although some are found apparently perfectly normal in which dilatation beyond 8 or even 7 mm. will cause splitting of the mucous membrane of the meatus which is usually the narrowest part of the canal.

The internal or vesical orifice of the urethra lies about 2 to 2.5 cm. back of the midportion of the symphysis pubis, and from here the tube extends downward and curves slightly forward to the external meatus which opens in the midst of the vestibule of the vagina about 2 cm. posterior to the base of the clitoris. In this position it lies directly anterior to the lower vagina and penetrates the urogenital trigone. Its external portion is usually lined by stratified squamous epithelium which merges posteriorly into the transitional type of epithelium, characteristic of the lining of the bladder, ureters and renal pelves. The point of change between these two types of epithelium, however, is variable, in some the transitional epithelium extending almost to the meatus.

The muscular coats are continuous with those of the bladder, and consist of an inner and outer longitudinal layer with a circular layer between them. The circular layer constitutes the involuntary sphincter which according to William T. Kennedy[123] is most efficient around the inner third of the urethra. The voluntary sphincter according to the same author is around the middle third and is derived from the urogenital trigone.

The subject of urethral or paraurethral glands is one concerning which there is a striking lack of unanimity of opinion. The glands of Skene, which are compound racemose glands whose ducts open into the floor of the urethra or either side just within the meatus, are definite structures the existence of which is not questioned. Hunner[67] states that there are many glands varying from simple tubular recesses or inversion of the mucous membrane above to the more complex glands of Skene below. Folsom[46] is strongly convinced of the presence of glands in the upper urethra and assigns to them an important rôle in chronic nonspecific urethritis. F. P. Johnson[104] on the other hand, who has made careful embryologic studies, finds that glands corresponding to that portion of the prostate which lies between the vesical orifice and the orifice of the prostatic utricle, develop early in the female embryo, but later regress and are repre-

sented only by shallow crypts mostly in the lower urethra in the term
infant and adult. Cabot and Shoemaker[11] who have made very
careful anatomic studies on autopsy material conclude that except
for Skene's glands there are no true glands present in the urethra.
They did, however, describe mucosal crypts, small cysts and cell
nests in the mucosa and submucosa which they believe are derived
from von Brunn's cell nests. Contrary to Folsom's belief they con-
sidered these of very little clinical significance.

2. *Congenital Anomalies.* An abnormal narrowing of the
urethral meatus in the absence of other evidence of disease is en-
countered not infrequently. Unless this condition is to be considered
as a congenital stricture of the meatus, as it is by William E.
Stevens,[192,194] the general statement that congenital anomalies of the
female urethra are extremely rare may be accepted without further
reservation. Aside from the above mentioned narrowing of the
meatus, hypospadias of varying degree is probably the most fre-
quently occurring type of anomaly. Indeed it is not uncommon to
find the urethral meatus opening closer to or slightly within the
vaginal orifice. This type of deformity usually produces no symp-
toms except perhaps slight spilling of the urine into the vagina result-
ing in dribbling, and as a rule no treatment is required. In severer
degrees of hypospadias the posterior wall of the urethra may be
entirely lacking, so that the bladder opens directly into the vagina.
Such cases require plastic operations designed for the construction of
an urethra. In cases of adrenal virilism the vagina, which is very
small and poorly developed, joins with the urethra 1 cm. or more
above the meatus so that there is only one orifice for the two canals.
This might be considered a type of hypospadias, but it usually causes
no inconvenience so far as the urinary tract is concerned; and in
view of the generally underdeveloped condition of the vagina the
defect should probably be considered as vaginal rather than urethral.

Davis[33] collected seventy-nine cases of epispadias in the female
from the literature prior to 1928. The meatus may open just above or
below the clitoris. In severer types there is complete absence of the
anterior urethral wall associated with nonunion of the pubic bones
and exstrophy of the bladder. Such a condition of course results in
complete urinary incontinence and can be treated satisfactorily only
by diversion of the urinary stream.

Cases of complete or incomplete double urethra have been re-
ported but are extremely rare, only four such cases having been

collected by Stevens.[194] Unless complicated by some other condition there should be no symptoms, as was the case of a patient reported by Dannreuther,[50] who complained of frequency and dysuria which were entirely relieved after removal of a caruncle found at one meatus of a complete double urethra.

Absence and atresia of the urethra have been reported but again are extremely rare. Stevens[194] has collected seven such cases from the literature. In three of these there was direct communication between the bladder and vagina with total incontinence, in three others, all newborn infants, there was no outlet for the urine, while the seventh case, a woman of forty-two had always urinated through the umbilicus.

Stevens[194] also has collected from the literature since 1552, fourteen cases of obstruction of the female urethra by diaphragms or valves. In eleven of these the obstruction was complete. The obstruction was at the meatus in ten, near the bladder in three and in the middle third in one. Five infants with complete obstruction were stillborn, and one died eight days after birth, while four were cured by perforation of the obstruction. In three patients with complete obstruction the urine escaped through the urachus.

3. *Inflammations.* Inflammatory lesions of the urethra occur frequently. They may be divided into acute and chronic urethritis which are common, and certain rarer conditions such as chancre, chancroid, granuloma inguinale and lymphopathea venereum.

Acute urethritis in women is due in most instances to gonorrheal infection, though occasionally an acute inflammation may result from invasion by other cocci or the colon bacillus. Trauma or chemical irritation may predispose to such a nonspecific inflammatory process. Stevens[192] states that in the examination of 1,064 women infected with gonorrhea, the specific organisms were found in the urethral discharge in 32 per cent. The disease in most of these women, however, was in a chronic stage. In the author's experience during the acute stages of gonorrheal cervicitis, the organisms can be found in urethral smears in practically every case, and not infrequently symptoms of burning on urination associated with frequency and urgency may appear before there is a profuse vaginal discharge. Thick pus can be expressed from the meatus by massaging the urethra through the vagina, and the gonoccocci can be identified in smears of this pus, often much more readily than in the cervical discharge. The slide from the cervix is more apt to be confusing because

of the presence of many bacteria of other varieties. Skene' gland are often involved and may give rise to abscess formation in which an incision and drainage is required. Aside from this, however, active manipulative treatment during the acute stage is to be avoided. To render the patient more comfortable fluids should be forced to reduce the concentration of the urine, which should also be rendered alkaline by the adequate administration of sodium bicarbonate. Warm sitz baths and the analgesics mentioned here are needed in those patients suffering acute distress. The same measures are applicable also to those cases of non-specific origin. The use of sulfonamide or its related compounds for the cure of gonorrheal origin is the treatment of choice. Sulfanilamide or sulfathiazole, given over a period of one week, will in this rather toxic state be curative, but it is our experience it is usually wise to continue the drug in much smaller doses from one to two weeks longer to insure a quiet recurrence. In the case of nonspecific origin the acute inflammation will tend to subside with the above mentioned palliative measures alone, if the inciting cause is removed.

Chronic urethritis has been considered in the past to have resulted most frequently from a gonorrheal infection, though several other types have been described and emphasized. With the increasingly widespread use of sulfanilamide and its related compounds during the acute stages of gonorrheal infection, the time will probably soon arrive, if indeed it has not done so already, when the above statement can no longer be said to be true. There probably always will be some patients, however, who, because of neglect in the acute stages, refractiveness to sulfanilamide therapy, or inability to complete an adequate course of such therapy because of toxic reactions, may pass from the acute into the chronic phases of the disease. A discussion of this phase of gonorrheal urethritis, therefore, is still appropriate and to the point.

The symptoms of chronic urethritis are apt to be the same as those of the acute condition but of milder degree. There is frequency and urgency with a stinging or burning sensation on voiding, and a constant dull pain, which at times may be sticking or stabbing in character, and may be referred to the suprapubic region, the vagina, or even higher in the abdomen along the course of the ureters. This tendency for pain resulting from chronic urethritis to be referred to other regions has often led to mistakes in diagnosis and unnecessary gynecologic operations or treatment. Terminal hematuria may also be present.

On examination the urethra will be found to be thickened and somewhat tender on vaginal palpation. If the disease has originated as a gonorrheal process, there may be evidence of a chronic cervicitis and chronic Bartholinadenitis. Skene's glands will usually be involved, and can be felt as pea-sized nodules on each side of and just posterior to the urethral meatus. In the chronic cases there may be little or no pus which can be expressed from the urethra and it may be quite impossible to identify the specific organisms. In such cases one must depend upon a history of an acute infection and the above mentioned findings for the etiologic basis of the condition. If there is an associated cystitis or pyelitis, the catheterized urine will contain pus, but more frequently this is not the case. Stevens,[192] Hunner,[68,77] and others have stressed the importance of stricture as an associated lesion requiring adequate treatment, but the nature of these strictures is not the subject of complete agreement among urologists. This subject will be discussed more fully in later paragraphs. For the moment suffice it to say that the urethra usually can be dilated less readily than in the normal state. After dilatation with Hegar dilators, a Kelly cystoscope of appropriate size should be introduced and gradually withdrawn, observing the lining of the urethra as it folds over the end of the instrument. In the normal state the longitudinal striae of the mucosa will appear as alternate light and deep pink rays extending from the center to the periphery of the field. When chronic inflammation is present, this appearance is replaced by one of diffuse reddening, and the mucous membrane appears rough and granular and tends to bleed easily. Some authors, notably Folsom,[46] Ormand,[165] Spence,[189,190] and Caulk[12,13,14] have stressed the proliferative tendency of lesions in the posterior urethra, and have described in addition to granulations, cystic formations in the mucosa and even polypi and papillomas: Folsom[46] in particular and also Caulk[12,13,14] have emphasized the importance of glands in the posterior urethra in the production of this type of lesion, but Cabot and Shoemaker,[11] after making very careful anatomic studies, came to the conclusion that there are no glands worthy of the name or capable of being clinically significant in this region, and Caulk[13] himself, in describing the histology of material removed from the vesical neck by the cautery punch, mentions no glands.

The etiology of many cases of nongonorrheal chronic urethritis is somewhat obscure. Ormond[165] found the condition at all ages, but more common in the middle age of life and in married women.

Spence[189,190] has found it frequently in children. Such factors as trauma of childbirth, irritation from coitus and masturbation, and associated lesions of the genital organs or rectum have all been mentioned as etiologic factors. Ormond[165] lists the following conditions as found in his series: anemia 52.5 per cent, gastrointestinal disturbances 48.2 per cent, focal infection 47.3 per cent, pelvic abnormalities 43 per cent, constipation 26.8 per cent, low basal metabolic rate 27.9 per cent and rectal abnormalities 19.4 per cent. He thinks that any of these may act as the etiologic factor in the individual case.

Hunner[65,77,91] has emphasized the rôle of distant foci of infection, particularly in tonsils, at the roots of teeth and in paranasal sinuses. He believes that in dealing with the obstinate chronic cases which resist all the usual methods of treatment, more of them are found to belong in the focal infection group than in that due to gonorrhea. "These focal infection urethritides are not accompanied by gross discharge. They occur in patients of any age. The catheterized urine is normal unless the patient has synchronous inflammation and infection in the tract above the urethra. Even in the very chronic gonorrheal case the usual methods of treatment soon result satisfactorily, not so in the focal infection case. In these, with or without treatment, we may have brief intervals of improvement in symptoms, but a cure is not obtained until the causative focus of infection is removed. In the case of a child, or in an adult, when one can exclude gonorrhea as a probable cause, it saves much time, useless painful treatment, and expense, if one locates a distant focus of infection and has this eradicated. It is one of the miracles of medicine to make the correct diagnosis in one of these cases and see the patient recover without further resort to urologic therapeutics. The victim may have suffered many years of discomfort in the pelvis and lower abdomen, and all varieties of bladder symptoms even to spells of total incontinence, and she may have had years of painful treatments aimed at the local lesions; and then, with the discovery and eradication of the causative focal infection, the symptoms cease within a few weeks, and urethroscopy shows that the formerly granular mucosa has returned to normal.

"One learns by experience to suspect a distant focal infection as the etiologic factor in any urinary tract lesion, whose symptoms appear only periodically, the intervals being marked by freedom from symptoms."

The treatment of the gonorrheal cases consists first and primarily of clearing up of persistent foci such as the cervix, Bartholin's glands and especially Skene's glands. If gonococci can be found in any of the discharges, a course of sulfanilamide therapy should be tried, though it is well recognized that the drug is much less apt to be effective in the chronic than in the acute stages of such an infection. A chronically infected cervix should be cauterized or subjected to some such procedure as the Sturmdorf operation, and palpable or cystic Bartholin's glands should be removed. The ducts of Skene's glands may be exposed by retraction of the external urethral orifice with hairpins, and using a fine hypodermic needle as a cannula, they may be aspirated and instilled with some antiseptic solution as suggested by Kelly. The eradication of infection in these foci, however, is usually accomplished more quickly and completely by widely incising the glands from the vestibular side, and thoroughly cauterizing the lining with pure carbolic acid or silver nitrate, or even with the actual cautery or fulgurating electrode. After such foci of infection have been eradicated the urethra should be dilated once a week attempting to achieve and maintain an eventual dilatation with a No. 10 Hegar dilator or larger. After each dilatation the urethral mucous membrane should be thoroughly swabbed with silver nitrate solution, using at first 3 per cent and gradually increasing to 10 per cent. Some authors suggest using solutions as strong as 20 per cent, and while these may be more efficient in the nonspecific cases with marked granulations and proliferative formations, in our experience they are usually not required to effect a cure in the case of gonorrheal origin. If the above methods are faithfully employed in the gonorrheal cases, a cure is usually effected within a few weeks, and failure in this usually indicates that the eradication of infection in all nearby foci has not been satisfactorily accomplished, or else that the case is one of nonspecific origin.

The treatment of chronic urethritis of nongonorrheal origin frequently offers a more difficult task than is presented by the gonorrheal cases. While urethral dilatations and the applications of silver nitrate will often given temporary relief, the symptoms are very apt to recur when treatment is stopped, unless all contributory factors such as distant foci of infection and lesions in the nearby genital organs have been discovered and eliminated. In the cases with granulations and polypoid formations such as are stressed by Folsom,[46] Ormond,[165] Spence[189] and others, stronger silver nitrate,

20 per cent solution, or diathermy fulguration have been found more effective. In attacking the problem of those patients whose symptoms often fail to respond to apparently adequate treatment, the
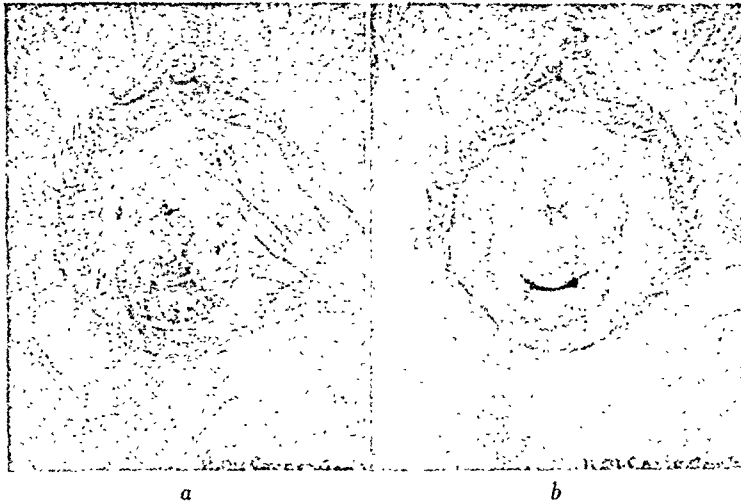
FIG. 5. The appearance of the vestibule of the vagina and the urethral meatus in a postmenopausal patient (a) before and (b) after treatment with estrogenic vaginal suppositories. The patient complained of frequency and dysuria for which no other cause could be found and which were relieved by the treatment.

fact should be kept constantly in mind that lesions of the urinary tract particularly those due to focal infection are often multiple. The association of chronic trigonitis with chronic urethritis is widely recognized, and Hunner has found "elusive ulcer" and chronic ureteritis or ureteral stricture often associated with urethral disease. Stevens[19] found that 46 per cent of his patients with urethral stricture and chronic urethritis also had ureteral stricture. The author has long felt and emphasized to students that the persistence of symptoms ordinarily thought of as originating in the bladder or urethra, even though the bladder urine may be normal, demands a complete investigation of the whole urinary tract. Such investigations will often disclose trouble above the bladder which when eliminated will result in symptomatic relief where other measures have failed; more important still, if such lesions had remained undiscovered and untreated, serious renal damage might have resulted.

During the past few years there has come under my observation a small group of patients presenting severe symptoms but mild signs of chronic urethritis, in whom all of the above mentioned etiologic

factors could be satisfactorily excluded. These patients have all been past the menopause and the onset of symptoms in each had been practically coincidental with the menopause. In several of them treatment along the lines described above were carried out over considerable periods of time without any appreciable permanent symptomatic benefit. On examination these patients have all showed signs of postmenopausal thinning and atrophy of the vaginal mucous membrane with splotchy areas of reddening, and this splotchy reddening has extended onto the vestibule and surrounded the urethral meatus which has appeared puffy and edematous. The administration of local estrogenic therapy in the form of vaginal suppositories of amniotin (Squibb) 2000 International Units each, one of which is inserted into the vagina nightly, has usually given relief in from seven to ten days. Treatment may then be discontinued but must be repeated at intervals of six to eight weeks to maintain relief. After such a course of therapy the reddening is found to have disappeared and the vestibular and urethral mucous membrane presents its normal healthy appearance. (Fig. 5.)

Chancre involving the urethra as with most of the female genitalia probably occurs much more frequently than it is seen. Because of the usual lack of subjective symptoms from this lesion it may run its course unobserved. When discovered antisyphilitic therapy should be instituted at once. Chancroid and granuloma inguinale are important chiefly because of the dense scarring that they leave on healing, which may result in dense strictures of small caliber which require dilatation over a long period of time. Recently it has been found that the healing of chancroidal lesions may be greatly hastened by the administration of sulfanilamide or sulfathiazole in about the same manner as they are used for gonorrhea.

There is a form of lymphopathea venereum which seems to attack primarily the urethra, and which has recently been thoroughly described by Gray.[54] The process is one of slow ulceration, which may be arrested at any stage with resulting stricture, or may progress to complete destruction of the posterior wall of the urethra up to the vesical neck, with a result simulating complete hypospadias and leading to complete urinary incontinence. (Fig. 6.) Other parts of the vagina, the vulva and the rectum are usually also involved. The appearance of the lesion is usually sufficient for diagnosis which can be confirmed by the specific skin reaction described by Frei.[47] Treatment during the progressive phase of the disease has been unsatisfac-

tory in the past, but recently some benefit has been ascribed to treatment with sulfanilamide. Eventually healing takes place spontaneously probably as a result of the acquiring of immunity on the

a   b
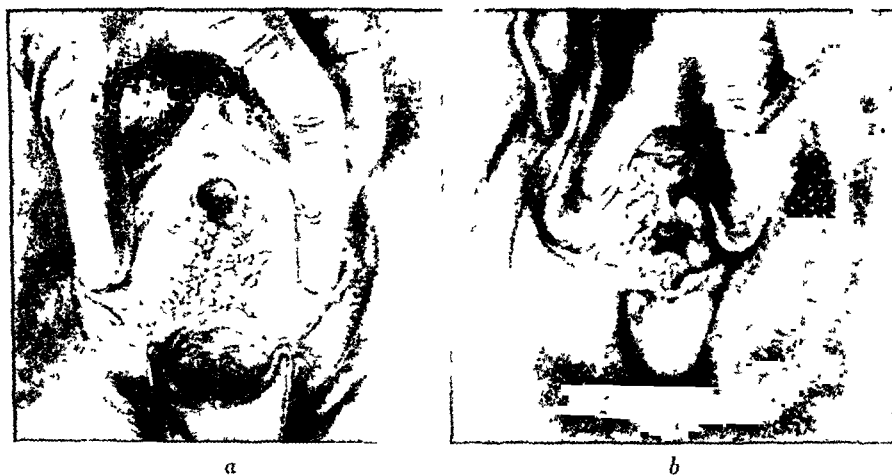
FIG. 6 a and b, two cases with destructive ulcerative lesions of the urethra due to lymphopathea venereum. (From Gray, L. A. Surg., Gynec. & Obst., 62: 745, 1936)

part of the patient. Treatment of defects resulting from the process require plastic surgical reconstruction of the urethra which will be described in connection with the treatment of urinary incontinence in general.

4. *Stricture.* That a wide divergence of opinion exists in regard to the incidence of stricture of the female urethra may be surmised from the following quotations both taken from "Practice of Surgery" by Dean Lewis: "Stricture of the female urethra is a very rare condition and usually occurs at or very near the urinary meatus," TeLinde:[198] and "It is only within a comparatively recent period that urethral strictures have been accorded the recognition they deserve as important etiologic factors in genitourinary tract disturbances in women and female children," Stevens.[193] Such diversity of opinion is probably best explained on the basis of difference in conception of what really constitutes a stricture. If we limit the term to mean such small caliber strictures as frequently occur in the male as a result of chronic gonorrhea and paraurethral abscesses and which are sufficiently tight to result in residual urine or sometimes even complete retention, then TeLinde's statement is undoubtedly true. In a large active clinic devoted entirely to females we probably do not see more than a half dozen such strictures in the course of a year, and these are usually the result of some such lesion as lymphopathea venereum or

granuloma inguinale. On the other hand, Hunner, who was for many years in charge of this same clinic, has repeatedly emphasized the frequency of a diffuse narrowing and infiltration of the urethra in association with chronic urethritis, and has emphasized the importance of thorough and repeated dilatations as a part of the treatment of these patients. Using Hegar dilators usually both for calibration and dilatation of the urethra, Hunner and those of us trained under him have been more impressed with the frequency of diffuse thickening and narrowing throughout the entire length of the urethra than we have with annular strictures. We have, however, frequently noted as has been emphasized by Stevens that, even in such diffusely infiltrated urethras, the region of the meatus seems to be the narrowest and most difficult to dilate, while in other patients a definite increase in resistance will be noted just before the dilator passes through the internal sphincter to enter the bladder. At times there is evidence of multiple areas of annular narrowing.

Most of the authors mentioned above as contributing to the subject of chronic urethritis, Folsom,[46] Ormond,[165] Spence,[189] Côte and Smith,[23] Hunner,[68,77] and Stevens,[192,193,194] have emphasized the importance of thorough and repeated dilatations of the urethra as a part of the routine treatment. Using olive tipped bougies to detect and locate strictures, in a number of contributions William E. Stevens[191–194] has emphasized their frequency and stressed their importance, not only as a contributing factor in chronic urethritis, but in other conditions of the urinary tract as well. He found 328 urethral lesions in 425 patients[191] with urinary disturbances, and 458 strictures in 1,227 patients examined.[194] In 85.6 per cent of these the stricture was at the external meatus and he believes that many of these may have been congenital, but that strictures in the canal and at or near the internal urethral orifice are nearly always acquired. He found the average size of the urethra in 118 adult women who had never suffered from urinary symptoms to be 26 French, while the average size in 174 strictures was 21.45 French. In another article[192] he states that acquired strictures of inflammatory origin are most often due to gonorrhea or ulceration and usually occur at or just within the urinary meatus, while strictures due to trauma are found both at the meatus and in the lumen of the canal and are usually the result of childbirth or operative procedures.

The symptoms of stricture as observed by Stevens[192,194] in order of their frequency of occurrence are frequency of urination, pain

which may be referred to the urethra, bladder, sacral, inguinal, or one or both lumbar regions, burning or smarting, urgency, difficulty, partial incontinence and dribbling. Residual urine, he states, is seldom found except in the presence of very tight strictures. Congenital strictures he believes are frequently the cause of enuresis in children, and are a frequent etiologic factor in the cystitis and pyelitis occurring in female infants and children. He also believes that tight strictures, like diaphragms or valves, are responsible for some of the cases of advanced hydroureters and hydronephrosis with destruction of the kidneys in infants born dead or dying shortly after birth.

The urine will be sterile and free from pus unless there is an associated urethritis, trigonitis, cystitis or pyelitis as is frequently the case. The strictures at times may be seen through the cystoscope but are best diagnosed by the olive tipped bougie as recommended by Stevens, or by graded Hegar dilators.

The strictures of larger caliber are usually satisfactorily treated by gradual and repeated dilatations with Hegar dilators. Sufficient anesthesia for this procedure can usually be achieved by the instillation into the urethral canal of a few cubic centimeters of a 1 to 500 solution of nupercaine (Ciba). Occasionally meatotomy or incision of the stricture may be necessary. When such a procedure is to be done, or when strictures of very small caliber are to be dilated for the fitst time, a general anesthetic is usually necessary.

Caulk[12] in 1921 reported a case of stricture in the region of the vesical sphincter which failed to respond to dilatations but was successfully cured by treatment with the cautery punch. Such cases must be rare indeed as by 1937 Caulk,[14] who had particularly emphasized them, had only encountered fifteen such cases in adult women and six in female children. In the fifteen adults twelve of the obstructions were due to inflammatory contractures and one to a papilloma. The symptoms were much the same as for other strictures with the addition of residual urine from 30 to 1000 cc. in twelve patients, overflow incontinence in four, and regurgitant renal colic in six. Eleven of the patients had pyelonephritis and the ureterovesical valves were incompetent in six. Ten were treated by the cautery-punch taking one to four bites, with satisfactory results. Histologic examination of the tissue[13] showed hypertrophy of connective tissue and smooth muscle in six, and epithelial hyperplasia in four. The production of a vesicovaginal fistula is mentioned as a possible

danger, but did not occur in Caulk's series, and no case is reported by him as having urethral incontinence as a result of treatment. Caulk mentioned reports of similar cases by Haufbauer, Nesbit, and Fite, and Thompson[202] has recently reported twenty-four cases from the Mayo clinic all of whom suffered from complete retention. The transurethral operation did result in stress incontinence in one of these. We have observed only one such case in our clinic. This was a patient of Dr. Hunner's in whom the contracture followed a post-operative infection in the space of Retzius. Transurethral operation relieved the retention but resulted in incontinence.

In a large and active clinic devoted exclusively to the handling of urologic conditions in women, the failure during many years to encounter other than this one patient whose urethral obstructions could not be satisfactorily relieved by repeated dilatations, emphasizes strikingly the rarity of the necessity for such procedures as the use of the cautery punch upon the vesical neck. Although no complications such as urethral incontinence or vesico-urethrovaginal fistulae followed this procedure in the skilled hands of Caulk, the potentialities of such complications are great, and although we have not seen patients in whom we deemed the cautery punch operation necessary, we have seen some with incontinence following its use elsewhere. We, therefore, believe that it should be strongly emphasized that this method of treatment of urethral obstructions in the female should be resorted to only after all other methods have failed.

5. *Suburethral Abscess and Diverticulum.* These conditions, while generally considered to occur but rarely, have been the subjects of numerous reports and are believed by some authors to occur considerably more frequently than they are observed. The diverticula at least because of their tendency to periodic emptying may readily be missed by an examiner. Cullen[27] in reporting a case in 1894 collected thirty-seven others from the literature, and Schmitz[177] in 1939 found one hundred cases in the literature and had observed eight cases in ten years on his own service. The cases reported are for the most part diverticula, and acute abscesses are but seldom mentioned. Two patients with acute abscesses, however, were recently admitted to the gynecologic service of the Johns Hopkins Hospital within a period of two weeks. In one in which the abscess was quite large involving the whole of the urethrovaginal and vesicovaginal septum (Fig. 7) no communication could be demonstrated between the abscess cavity and the urethra. In the other with a smaller

abscess such a communication was present and pus could be expressed from the urethra. Both patients presented the same symptoms of gradually increasing difficulty in voiding over a period of two
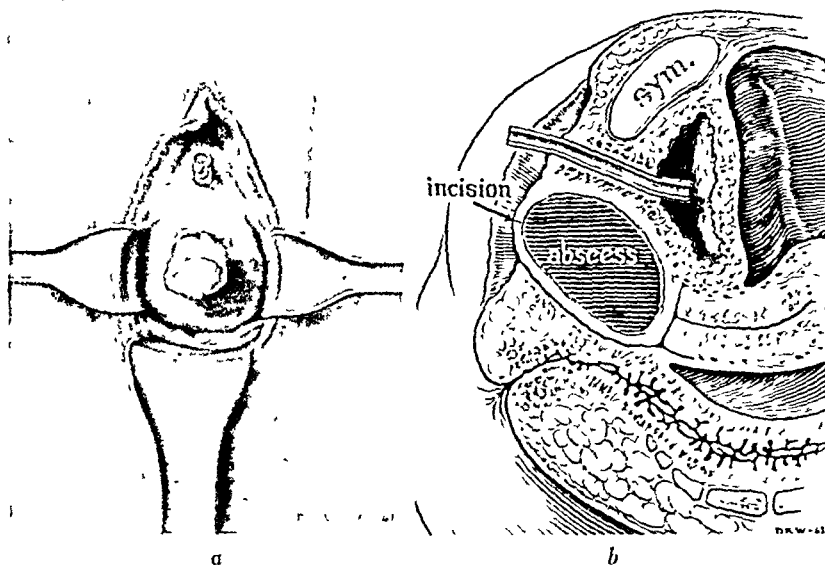
FIG. 7. *a*, direct view of a large suburethral abscess with the patient in the lithotomy position. *b*, schematic drawing of a medium longitudinal section through the same abscess.

weeks, culminating finally in acute retention of urine. Fever and leucocytosis were present in both, though these were of greater degree in the patient with the larger abscess without urethral communication. Both abscesses were incised and drained through the anterior vaginal wall, and anaerobic streptococci were grown from the pus obtained in each instance. An inlying catheter was left in the bladder for forty-eight hours in each case, and both patients voided normally after removal of the catheter. Healing was satisfactory in both, and on subsequent examination no urethrovaginal fistula had occurred in either. Although the development of such a fistula might readily occur in those cases with a communication between the abscess cavity and the urethra, incision and drainage is the only satisfactory method of treatment for a true abscess. If such a fistula should occur, closure may be attempted later.

Many theories have been advanced as to the etiology of urethral diverticula. Cysts may arise from congenital rests in the urethrovaginal septum such as Gärtner's duct or occluded paraurethral

[23]

glands. Clark M. Johnson,[103] who reported a suburethral cyst, which did not communicate with the urethral lumen, occurring in a newborn infant, believes that such cysts may occur frequently and become converted into diverticula by rupturing into the urethra. J. Craig Neel[160] reported a case which he believed to be congenital in origin, because of the absence of urinary infection, the insidious onset of symptoms without pain or tenderness, and the unusually large communication with the urethra which extended upward to involve the region of the internal sphincter and vesical orifice. The consensus of opinion among most of those who have contributed to the subject, however, is that in most instances urethral diverticula are acquired rather than congenital. Some authors make a distinction between true diverticula in which all coats of the urethra can be identified in the wall of the diverticulum, and false diverticula or urinary pockets in which these structures cannot be found. Such a distinction, it would seem, is of little practical importance.

Schmitz[177] mentions structural weakness, trauma usually from labor, and infection as the most common etiologic factors in acquired diverticula. The formation of a diverticulum to accommodate a stone lodged in the urethra behind a stricture was mentioned by Cullen[27] and in 1934 Shivers and Cooney[184] who reported such a case, were able to find reports of twenty-two others. A more recent review by Gaston and Ferrucci[50] has brought the total number of such cases reported up to thirty-four.

The symptoms are usually pain in the region of the urethra and vagina which is accentuated in the sitting position and particularly during coitus. A tender mass may be observed and felt protruding from the vaginal orifice. There is usually a history of intermittent discharge of cloudy or purulent urine from the urethra, which is followed temporarily by relief of symptoms. The urine is often infected in which case frequency, urgency and pain on urination will be present.

Examination reveals a fluctuating, somewhat tender mass in the urethrovaginal septum, compression of which results in the discharge of cloudy urine from the urethral meatus. If multiple calculi are present crepitus can be elicited. The opening in the floor of the urethra can be demonstrated through a Kelly speculum, and an opaque solution may be injected through this opening into the sac for the purpose of obtaining a roentgenogram, though such a procedure is not necessary for diagnosis.

The treatment should consist of excision of the sac through a vaginal incision with careful closure of the urethral opening and reconstruction of the structures beneath the urethra. Shivers and

a   b

c
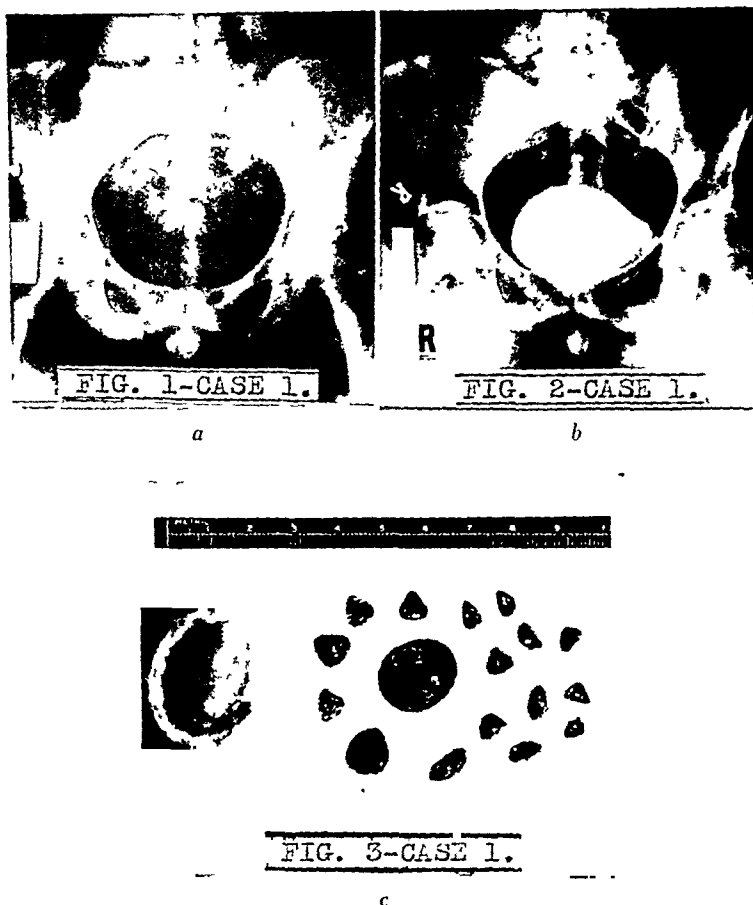
Fig. 8. Illustrating a case with calculi in suburethral diverticulum. Fig. 1, a, Case 1. Glass catheter in bladder. Mottled dense shadow below symphysis showing calculi in sac of diverticulum. Fig. 2, b, Case 1. Cystogram with 200 cc. Three per cent NaI; catheter removed, mottled character of shadow of multiple calculi rather more distinct. Fig. 3, c, Case 1. Photograph of half of sac wall after shrinking by the fixative. Seventeen calculi. (Figure and legends from Hunner, G. L. Urol. & Cut. Rev., 42: 336, 1938.)

Cooney[184] employed a preliminary suprapubic cystotomy to divert the urine from the urethra, but such a procedure has not been found necessary by most surgeons. Furniss[49] feels that success is more apt to result if the sac is merely excised, the neck fulgurated, and the cavity packed at first, and the reconstruction procedures carried out

at a later date. In general, however, except in the presence of an unusual amount of inflammatory reaction in the tissues, such a two-stage procedure would not seem necessary. Hunner[96] who has recently reported three cases with calculi, has described the technic of the usually most satisfactory treatment so well that some direct quotations may be used:

"The treatment is practically the same whether a stone is present or not." If the urethra is strictured it should be dilated first and this "had better be done repeatedly in slow stages over a sufficient period of time to avoid open rupture of the tissues and bleeding. Severe trauma at the time of operation is likely to result in more scar-tissue and backpressure of the urine on the site of the mucosa repair where the sac is cut from the urethral wall." The operation is best done with a Hegar dilator or sound, as large as the urethra will accommodate comfortably, constantly in the canal. The anterior vaginal wall is then incised in the midline and the sac carefully dissected out and severed from its attachment to the urethra. The defect in the urethral mucosa is closed with a purse-string suture of fine forty-day chromic catgut. The suburethral tissues are brought together with interrupted sutures of fine chromic catgut and if there has been incontinence or other evidence of sphincter weakness, the urethral sphincter and tissues beneath the vesical neck should be plicated with mattress sutures of silk according to the Kelly technic. Hunner suggests that the redundant vaginal mucosa be trimmed away from only one side, so that the flap from the opposite side may be brought across the midline and sutured with silk or fine silver wire. In this way one can avoid having the line of suture of the vaginal mucosa lying directly over those in the deeper tissues. The vagina should be packed with gauze for forty-eight hours to obliterate dead space, and a rubber catheter should be left in the bladder for three or four days. The patient may be up on the fifth or sixth day but the vaginal sutures should not be removed until the tenth day.

6. *Prolapse.* The term prolapse is used at times to refer to a sagging of the entire urethra toward the vagina and its outlet as a result of weakening of the supporting tissues in the anterior vaginal wall. Such a condition is in reality an urethrocele, and confusion will be avoided by limiting the term prolapse to an eversion of the mucous membrane of the urethra through the meatus. This condition appears as a red congested tumor-like mass protruding between the labia minora, which may vary from 1 to 4 or 5 cm. in diameter. The

mass exudes a serosanguinous fluid and not infrequently thrombosis may occur with resulting gangrene, in which event the tumefaction assumes a dark purplish color.
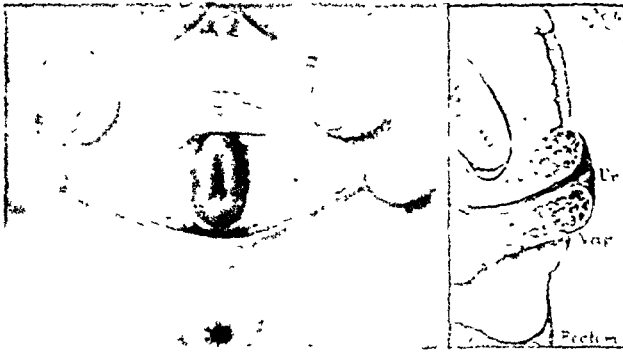
Fig. 9. Prolapse of urethra. The sagittal section shows dilated thrombosed blood vessels which impart a dark red color to the strangulated mucosa. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

The condition is rare and is apt to occur most often in childhood or advanced old age, although cases have been reported in patients in the middle period of life. Keefe[105] found 60 per cent in children under fifteen years of age, and 28 per cent in women over forty years, with only 12 per cent between the ages of fifteen and forty.

The onset of the condition may be gradual or sudden. The chief predisposing cause is generally considered to be a weakness of the urethral wall which may be congenital, the result of trauma such as may be sustained during delivery, or the result of general weakness and debility. As precipitating causes such factors as cough, straining at stool, vesical tenesmus, bladder calculi, and parturition have all been mentioned. Chute[16] has reported three cases with moderate degrees of prolapse all of which had been treated as caruncles. When the symptoms were not relieved, further investigation disclosed the presence of a bladder tumor in each case. Such a possibility should certainly not be overlooked in searching for the cause of prolapse. Keefe[1] believes that a neuromuscular disturbance resulting in too forceful activity of the detrusor urinae muscle may be an important factor.

The symptoms may be relatively slight and consist merely of the presence of the tumefaction with its serosanguinous discharge, or there may be frequency and burning on urination, or even difficulty in voiding with severe vesical tenesmus.

Various treatments have been recommended, but in general non-surgical methods such as the application of astringent compresses have met with little success. Of the surgical procedures used that recommended by Kelly and Burnam[121] has probably been employed most often as it is applicable to both children and adults, and despite the fact that it has not met with the approval of some (Keefe,[108] Livermore[139]) it has generally been reported as giving highly satisfactory results. In this procedure the base of the tumor is first transfixed with a suture to prevent retraction of the mucous membrane. The tumefaction is then excised and the margins of the urethral mucosa are sutured to the vestibular mucosa in a manner similar to the Whitehead operation for hemorrhoids. Emmet's "button hole" operation consists of a small incision through the anterior vaginal wall down to the urethral mucosa through which the mucosa is drawn thus retracting the prolapse. The redundant mucosa is removed and the defect closed after which the vaginal incision is closed. Keefe[108] recommended a reduction of the prolapse after which the urethral wall throughout its whole length was tightened by sutures through a vaginal incision. Both of these procedures are only applicable to adults. Hepburn[60,61] has used successfully a suprapubic approach through which the vesical neck is freed and lifted upward until the prolapse is seen to disappear. The bladder neck is then sutured to the periosteum of the pubic arch. Livermore[139,140] has been successful with mere fulguration as he says "at four points of the compass." Such a procedure should be most useful in the very elderly patient who is hardly a good risk for more extensive procedures. Before this is done, however, at least a small piece of the prolapsed tissue should be excised for microscopic study in order surely to differentiate it from carcinoma. TeLinde (personal communication) has successfully fulgurated the whole mass, but in most cases the procedure recommended by Livermore is probably adequate and less apt to result in a stricture of the urethral meatus.

7. *Neoplasms.* Except for caruncles true new growths of the female urethra occur very rarely. In a series of thirty-five patients reported with what they termed proliferative lesions, Walther and Willoughby[212] in 1935, included three cases of cysts of the paraurethral glands, and one of prolapse of the urethral mucosa. These of course should not be considered as new growths. Of the new growths there were four papillomas and the remaining cases were either caruncles or carcinomas. In their series in only fifteen was a path-

ologic examination made of the lesion. Of these fifteen one showed definite carcinoma, while a suggestive carcinomatous or "precancerous" lesion was found in five others. In three of these the suggestive
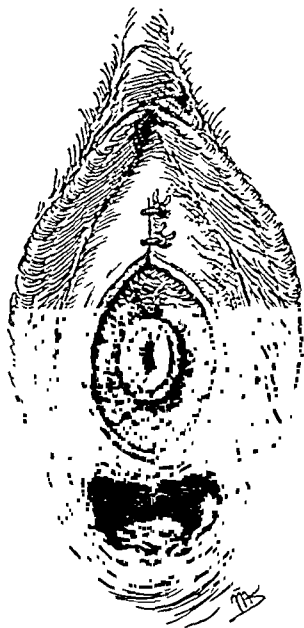
FIG. 10. Appearance after circular amputation of prolapsed and hypertrophied urethral mucous membrane. The wound is closed from side to side, above and below with interrupted fine catgut sutures. The remaining central portion is united to the urethral mucosa on the two sides. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922, D. Appleton & Co.)

malignant changes had occurred associated with an old chronic inflammation, while in two others they were found in caruncles. These findings led the authors to the following conclusion sufficiently important to be worthy of direct quotation:

"The many reports received in personal communications from leading urological clinics throughout the country, as well as a study of the series herewith reported, reveal the fact that many of the

proliferative lesions of the female urethra removed and studied microscopically show either malignant or premalignant changes. A warning, therefore, should be sounded against the removal of such
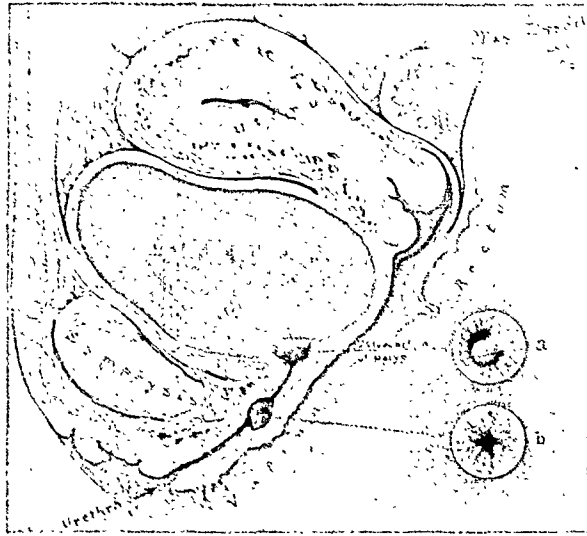
Fig. 11. Mucous polypi of urethra and sphincter region of the bladder. The smaller drawings, (a) and (b), show the polypi as seen through a Kelly cystoscope. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

lesions by the haphazard methods often employed (actual cautery, and so on), without submitting biopsy specimens to the pathologist in every instance. It is only by routine studies that the actual incidence of urethral carcinoma in women can be determined."

These authors do not state the location in the urethra of the papillomas but Folsom[46] and others have described such lesions occurring in the posterior urethra near the sphincter on the basis of a chronic urethritis, and Kelly and Burnam[121] illustrate probably the same lesion under the name mucous polypi. (Fig. 11.) Such lesions after the removal of adequate biopsy specimens may be further destroyed by thorough fulguration. Fibromas and sarcomas of the urethra do occur but have been reported but rarely. Kelly and Burnam[121] cite in brief detail seven cases of myomas or fibromas collected from the literature and mention twenty-seven others collected by Lönnberg. The same authors cite fourteen cases of sarcoma as having been collected by Ehrendorfer, and twenty-two of 149 cases of malignant tumor collected by Menville and Counseller[154] in 1935, were of this variety.

Caruncle. These tumors occur frequently and appear as small brilliant red, soft masses attached to the mucous membrane of the posterior aspect of the urethral meatus. They are usually only a few millimeters in diameter but may be considerably larger. They may be sessile or attached by a pedicle. Occasionally they may be multiple and spring from the entire circumference of the external orifice.

Microscopically they may appear as polypi with a loose fibrous stroma containing many thin-walled blood vessels and usually infiltrated with inflammatory cells, round cells and polymorphonuclear leucocytes. The vascularity is so marked in some that they have been considered as angiomas. The surface is covered by stratified squamous epithelium or by transitional epithelium in about equal proportions of the cases (Olcott[164]), and occasionally both types of epithelium may be found in the same specimen. The epithelium often tends to dip down into the stroma forming crypts, with resulting patterns which on cursory examination might suggest carcinoma. More careful examination, however, usually shows a uniformity of cell structure and lack of nuclear activity which leaves little doubt of their benign nature. At times the structure is typically papillomatous.

These tumors may be entirely insensitive and produce no symptoms. On the other hand many of them are exquisitely sensitive, and when this is the case the patients suffer severely from urethral pain; and although frequency, urgency and dysuria are present as a rule, the pain on voiding may be so great that the patients may voluntarily refrain from doing so to the point of overdistending the bladder. The symptoms from these apparently insignificant tumors may be so distressing as to shatter the nerves of the patient completely.

Various technics have been suggested for treatment including incision and suture, destruction with chemicals or the actual cautery and fulguration. In general there are three important principles that should be observed and provided this is done the actual technic is not important: These principles are first that a sufficient amount of the tumor be removed and preserved for microscopic study, secondly, that the mucous membrane at the base must be completely removed or destroyed to prevent recurrence, and thirdly that the removal or destruction must be done in such a way as to avoid scarring sufficient to produce a stricture of the meatus. We have found excision of the tumor with fulguration of the base a simple and satisfactory procedure, which usually can be carried out under local anesthesia, except

in those patients rendered highly nervous by the extreme sensitive-
ness of the lesion. The patient should be warned of the great tendency
to recurrence and advised to seek prompt treatment and not to worry
about cancer.
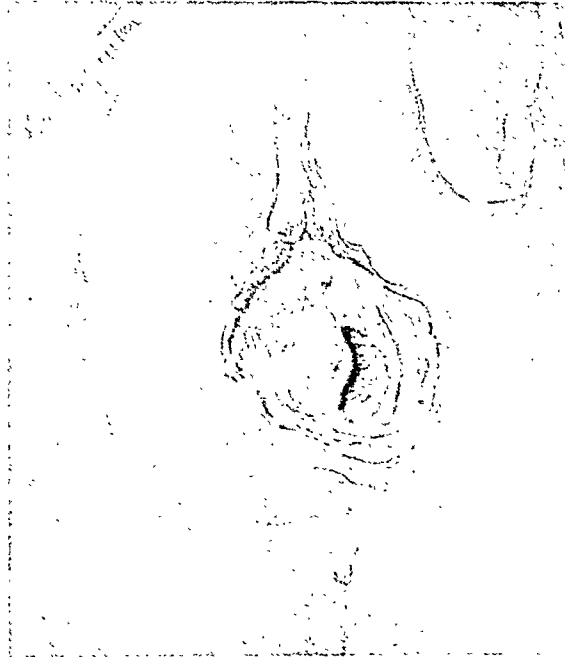
Fig. 12. External genitalia of a girl aged ten,
showing a bulging prominence to the right of
the vaginal orifice. This prominence marked
the site of the orifice of an ectopic ureter, and
a steady dripping of urine occurred from this
region. (From Everett, H. S. *South. M. J.,*
31: 843, 1938.)

Carcinoma. Carcinoma of the female urethra, while rare, occurs
more frequently than any other truly neoplastic lesion except
caruncle. Menville and Counseller[154] in reporting a case in *1935* found
149 other cases of authentic malignant neoplasms in the literature,
of which twenty-two were sarcoma and the rest carcinoma. In a more
recent study Sala and Levine[174] found 262 reported cases. Olcott[164] in
reviewing the cases of caruncle in the records of the New York
Hospital could find no case of carcinoma, and in 1923 Shaw[183] was
able to find only twelve cases reported in the British literature.
Whitehouse,[219] who was later quoted by Watson[216] divided the
tumors into vulvo-urethral and urethral types, and of the forty-three
authenticated cases which he (Whitehouse) was able to collect, thirty-
two were of the former variety. This fact may in part account for the

infrequency of reports, since in the advanced stages of the vulvo-urethral variety it is impossible to determine whether the tumor was primarily vulval or urethral in origin. The cases collected by White-house ranged from twenty-six to sixty-nine years of age with an average of fifty-four, and in Crossen's,[25] twenty-five collected cases the youngest was twenty-eight and the oldest seventy.

Although, as is always true of neoplastic diseases, nothing definite can be said as to etiology, the frequency with which carci-nomas have been preceded by caruncles, or chronic inflammatory lesions has been stressed by a number of writers, notably Pugh,[170] Watson[216] and Crossen.[25] This fact tends to enhance the value of the quotation cited above from the article of Walther and Willoughby[211] as to the importance of biopsy in proliferative lesions.

The majority of the tumors histologically are found to be squamous cell epitheliomas, although some adenocarcinomas, prob-ably arising from paraurethral glands have been reported. Of the cases collected by Whitehouse[219] twenty-seven were of the former and fourteen of the latter varieties. The case reported by Menville and Counseller[154] was described as a mucoid carcinoma. Whitehouse[219] divided the vulvo-urethral tumors into three groups according to gross characteristics, namely, papillomatous resembling caruncles, ulcerating lesions at the meatus, and slow growing, nonulcerated, indurated lesions encircling the meatus. The true urethral growths he divided into two groups: elongated ulcerating growths involving the floor of the urethra, and periurethral infiltrating growths which tend to occlude the canal. Metastases from the vulvo-urethral variety tend to occur first in the inguinal lymph nodes, while those from the urethral variety reach the deep pelvic nodes first. A case has been reported by E. C. Shaw[182] in which the tumor surrounded the urethra but did not involve the mucosa. The primary tumor disappeared following irradiation, but two years later the patient died from bilateral ureteral occlusion due to metastases in lymph nodes quite high along the ureters.

The symptoms are usually pain in the region of the urethra with frequency, urgency and difficulty in voiding. Complete retention of urine may occur in the more advanced cases. There is often a bloody discharge and the urine contains blood.

The prognosis is generally stated to be poor although of the twenty-five cases collected by Crossen,[25] eleven had survived for more than two years. W. F. Shaw[183] has called attention to the fact

that most cases have been reported before enough time had elapsed after treatment to permit of satisfactory evaluation as to results.

Four methods of treatment have been advocated as follows: (1)

a   b
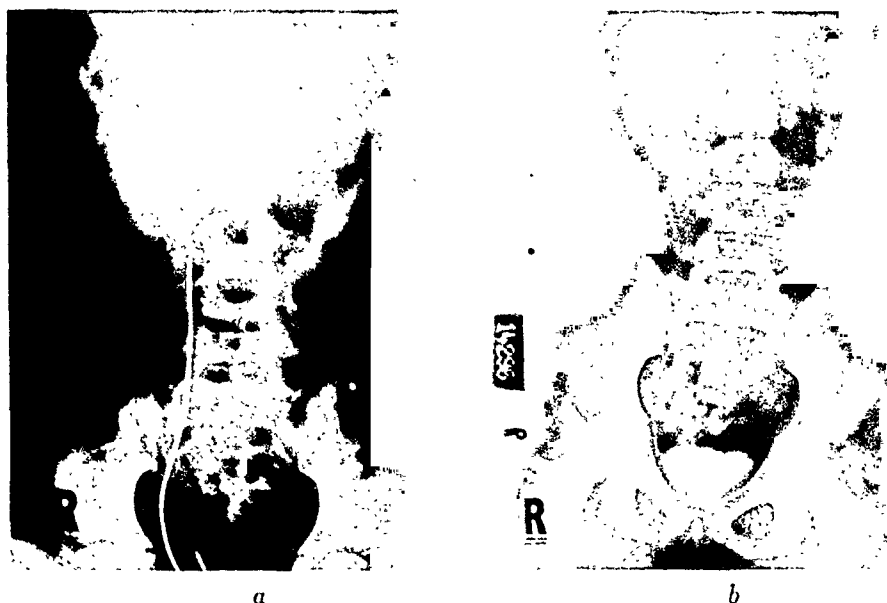
FIG. 13. Intravenous pyelograms of the same patient illustrated in Figure 12, (a) before and (b) eight months after abdominal ligation and partial resection of the aberrant ureter. In (a) the normally placed right ureter draining the lower segment of a double pelvis had been catheterized, and the catheter plugged to prevent the escape of the opaque solution. (From Everett, H. S. *South. M. J.*, 31: 843, 1938.)

Radical excision of the urethra and surrounding tissues including a portion of the bladder neck. The defect in the bladder is closed and drainage instituted through a vaginal or suprapubic cystotomy wound. (2) Less radical excision leaving the vesical neck and sphincter region. This procedure was used successfully in two cases by Crossen[25] who first diverted the urine through a vaginal cystotomy. He took particular pains to tighten the tissues around the vesical neck by three purse-string sutures and then covered the raw areas by transplanted flaps of vaginal mucous membrane. His efforts were rewarded by complete urinary control. (3) Excision or high frequency loop extirpation of the tumor followed by radium and roentgen therapy as advocated by Walther and Willoughby.[212] (4) Radium and roentgen therapy alone.

In the cases treated surgically the inguinal lymph nodes should also be removed. The decision as to methods of treatment must be decided on the individual merits of each case, but it would seem that

a

b

c

d
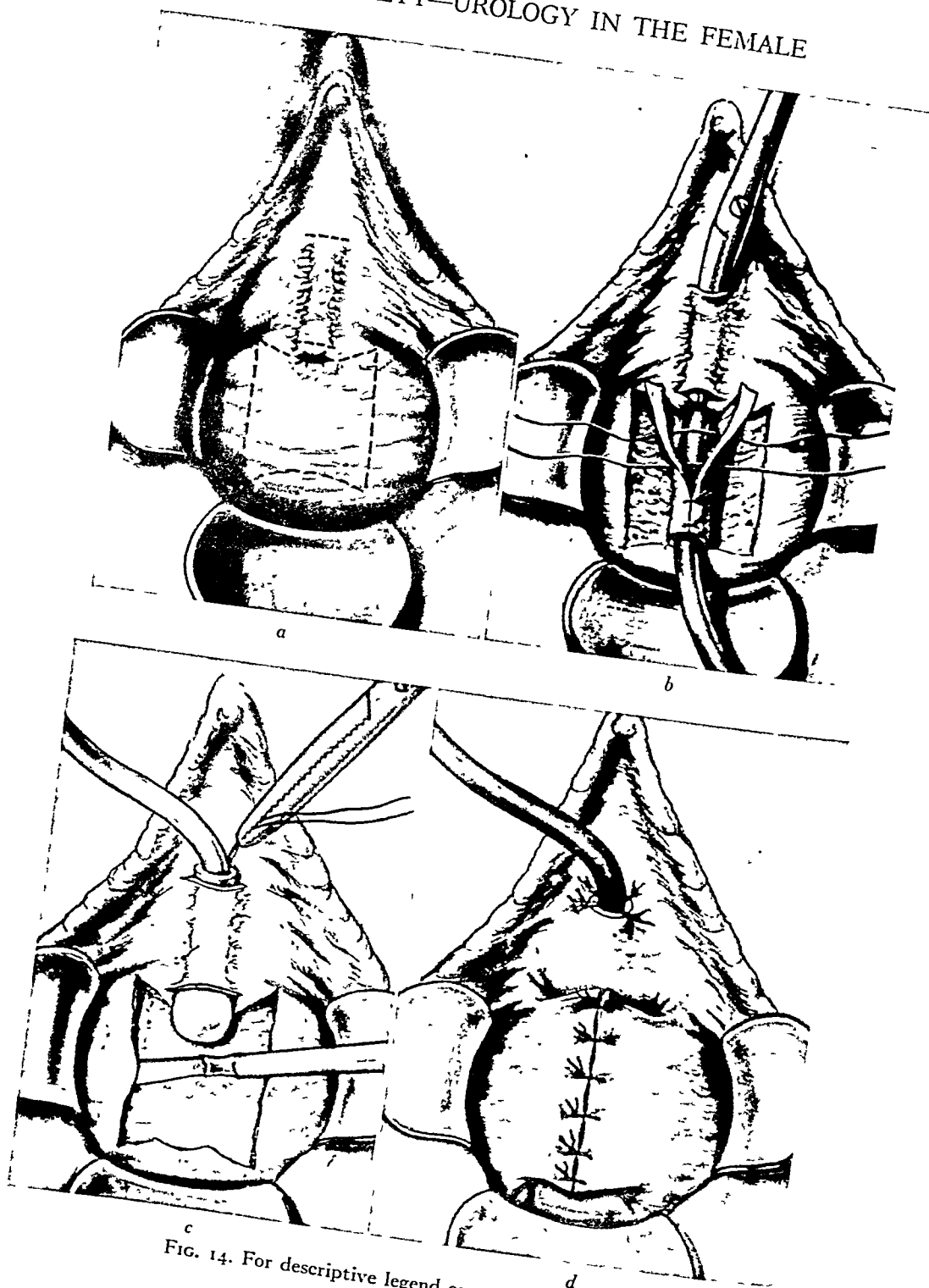
FIG. 14. For descriptive legend see opposite page.

in cases sufficiently advanced to require the more radical type of operation, irradiation would be preferable to the mutilation and permanent incontinence necessarily resulting from such a procedure. Although no suggestion of it has been found in the literature, it would seem that in those cases in which irreparable defects and and incontinence result from operation, it might be worth while to divert the urine by transplantation of the ureters into the bowel.

IV. INCONTINENCE OF URINE

Incontinence, or the inability to control the outflow of urine, may vary in degree from an occasional slight involuntary escape of a few drops to the complete and continuous uncontrolled flow of the entire urinary output. While in its lesser degrees this symptom may cause merely a slight annoyance to the patient, those suffering from the severer degrees of incontinence, because of the constant wetting of the clothing and the attending foul uriniferous odor, in the words of Kelly and Burnam[121] "commonly live a recluse life, rarely seeing anyone outside of the immediate tolerant family." Because of the variety of causes of this condition in the female and the challenge which the difficulties of its correction often present, it is a subject which has engaged the attention of skilled gynecologists and urologists since the epoch making work of Marion Sims[185] on the cure of vesicovaginal fistula.

The causes of incontinence which occur in the female may be listed as follows:
1. Congenital defects of the urinary system:
   a. Hypospadias.
   b. Epispadias.
   c. Exstrophy of the bladder.

FIG. 14. Method of reconstruction of the urethra as described and used independently by G. G. Ward, J. A. McGlinn and S. H. Geist. (a), shows the scarred site of the previous urethra and the fistulous opening. The dashed lines above the opening illustrate the position of the openings of the tunnel. Dashed line below the fistula is outlining the mucosal flap for tube. (b), the tunnel completed, the flap mobilized, the new urethral tube in the process of completion. Note the thickness of the flap in the proximity of the new urethrovesical junction. (c), the new urethral tube drawn through the tunnel by means of traction sutures. The catheter which is passed through the new urethral tube into the bladder also drawn through the tunnel. (d), the complete operation, the new urethral tube anchored at the upper margin of the tunnel. The vaginal mucosa sutured covering the denuded area and bulbous end of the urethra. The catheter in place. (Figures and legends from Geist, S. H. Am. J. Obst. & Gynec., 39: 843, 1940.)

d. Anomalous ectopic opening of an ureter outside of the bladder.

II. Defects of the urinary system resulting from trauma or disease:

a. Weakening or relaxation of the urethral sphincter mechanism.

b. Destruction of the urethra, partial or complete.

c. Urethral, vesical and ureteral fistulae.

III. Lesions of the nervous system involving the nerve control of micturition:

a. Congenital lesions such as spina bifida occulta.

b. Acquired lesions such as tabes dorsalis, multiple sclerosis, spinal cord tumors, transverse myelitis, Pott's disease and traumatic injury of the spinal cord.

1. *Congenital Defects.* The congenital defects of hypospadias and epispadias as mentioned in a preceding section are extremely rare. As these conditions may be closely simulated by defects resulting from trauma or disease, their surgical correction will be discussed later in connection with the correction of such acquired defects. Exstrophy of the bladder, a most distressing condition, is fortunately also rare. Although attempts have been made from time to time to correct such defects by plastic procedures, complete failure has usually been the reward, and it is now generally accepted that the only satisfactory treatment is diversion of the urinary stream by transplanting the ureters to the bowel, after which the exposed open bladder should be excised.

In 1938, the author[40] reported three cases of ectopic ureteral orifice and reviewed the literature up to that date. This review revealed that about 200 such cases had been reported, about two-thirds of which were in females. Kilbane,[124] in 1926, reviewed 100 cases, of which sixty-five were in females and thirty-five in males. Thom,[201] in a collected series of 185 cases, found 122 females and sixty-three males, and Sargent,[175] whose series is the same as Thom's, with one case of his own added, found 123 females and sixty-three males. Furthermore, the diagnosis is made clinically much more frequently in females. In Kilbane's series the diagnosis was made clinically in fifty-seven of the sixty-five females and in only two of the thirty-five males, thirty-three males and nine females having been diagnosed at autopsy examination. In Sargent's series ninety-four of the 123 females were diagnosed clinically and only six of the sixty-three males. The others were diagnosed at autopsy examination.

[37]
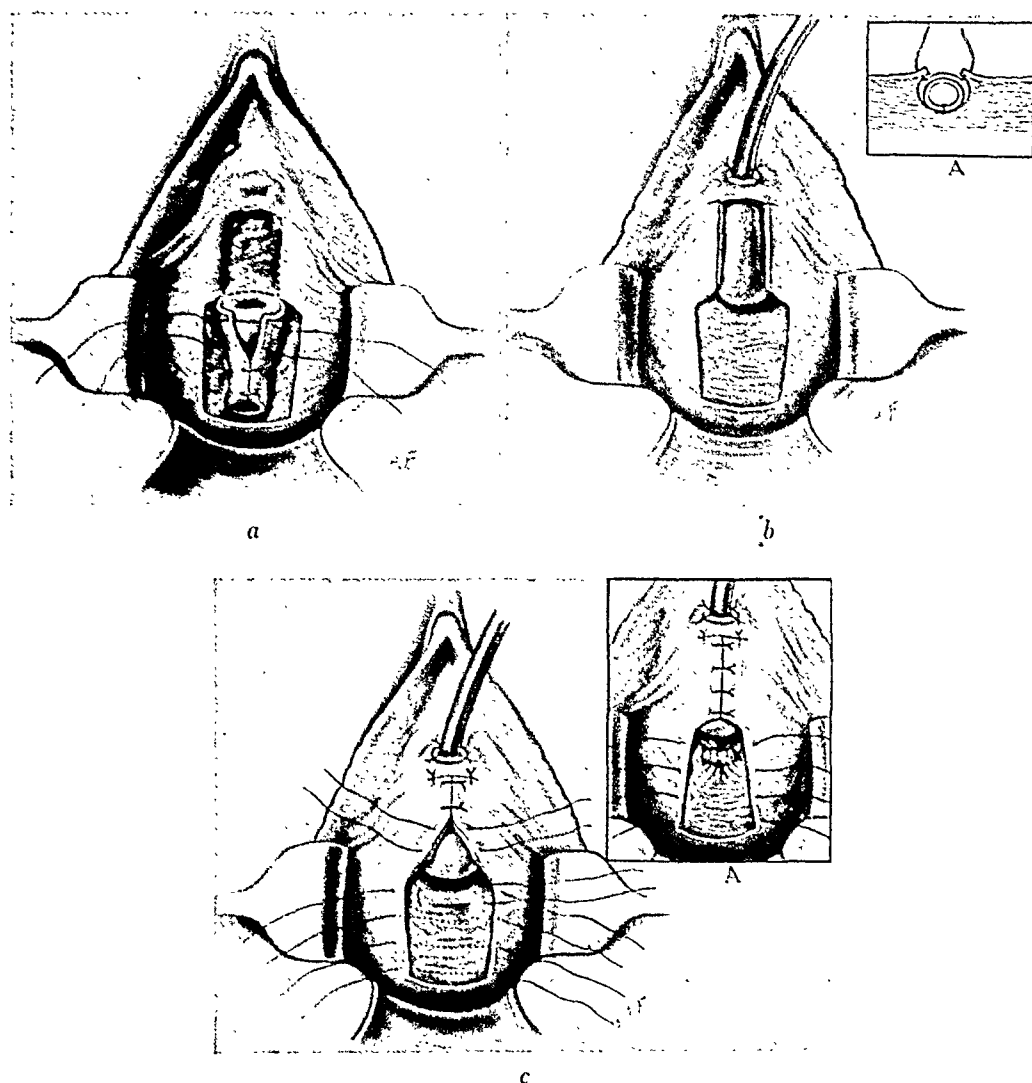
Fig. 15. Dr. George Gray Ward's more recent modification of the operation for recon-
struction of the urethra. (a), the dotted line shows the site of the destroyed urethra
with the external meatus intact and a vesicovaginal fistula at the neck of the bladder.
As suggested by Farrar the quadrangular flap dissected from the anterior vaginal wall
and sutures passed to convert it into a tube. Note the upper margins of the flap end
above the fistula. (b), a catheter is passed through the tube and into the bladder and
the new canal is laid in a deep "U" shaped excavation that has been made at the site
of the original urethra. See insert A. (c), the end of the canal sutured to the external
meatus, and the margins of the excavation brought together with sutures over the new
urethra. A mattress stitch (Kelly) is placed at the neck of the bladder. Insert A shows
the mattress suture tied, and the sutures placed to close the vaginal denudation.
(Figures and legends from Ward, G. G. Surg., Gynec. & Obst., 58: 67, 1934.)

The failure to make a clinical diagnosis in the male, according to Sargent,[175] is due to the fact that the aberrant opening which may be situated in the prostatic urethra, ejaculatory duct, seminal vesicle, or vas deferens, is always within the external urethral sphincter so that urinary leakage is not a symptom. In the female, on the other hand, the misplaced orifice may occur within the urethra, in the vestibule, or within the vagina or uterus, and urinary incontinence is nearly always a symptom leading to search for and discovery of the anomaly. In an occasional case, where the ureter which opens into the urethra is subject to pressure from the urethral sphincter, incontinence may not occur. Such a case has been reported by Davis[32] who collected five other similar ones. The incontinence which is usually present in the female is of a peculiar type in that there is a constant leakage of urine but at the same time normal periodic voiding. This symptom is practically pathognomonic of such an anomaly and attention to this point on the part of pediatricians should lead to earlier diagnosis of the condition than has generally been the case in the past. The frequent association of serious lesions of the upper tract with these anomalies suggests that early diagnosis and treatment may be of considerable importance.

Treatment in the past has consisted of nephrectomy, heminephrectomy, ligation of the ureter either abdominally or vaginally, or some type of implantation of the ureter into the bladder, and in two cases anastomoses were performed successfully between the two pelves. According to statistics collected by Sargent,[175] nephrectomy and heminephrectomy have met with success in all cases in which they have been used, the former in twenty-two cases, the latter in sixteen. When the normally drained segment of the kidney is normal or nearly normal, nephrectomy seems too radical, for the presence of a stricture or its later development in the remaining ureter, or injury of any sort to the remaining kidney or ureter may jeopardize the life of the patient. The various types of operation for transplantation of the aberrant ureter into the bladder were successful in thirty out of forty-six cases. The greatest incidence of failure was in those cases in which the transplantation was done through a vaginal approach, eight failures out of twenty-six cases. Some type of transplantation is justifiable and even strongly indicated where the aberrant ureter is the only one draining a well functioning kidney; but when, as is usually the case, the aberrant ureter is the one draining the upper pelvis of a double kidney, the function of the segment drained by it is

usually insufficient to warrant any great effort to save it. When this is considered together with the fact that transplantation often leads to an intractable cystitis in a previously normal bladder, these types of operation seem contraindicated in most cases.
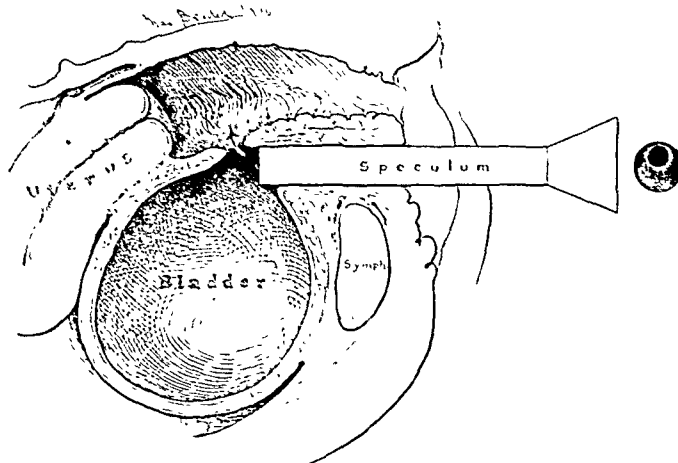
FIG. 16. Sagittal view illustrating examination of a vesico-
vaginal fistula through a Kelly cystoscope. The small
diagram to the right shows the speculum view of this
fistula with the surrounding bladder mucosa. (From
Kelly and Burnam. Diseases of the Kidneys, Ureters,
and Bladder. New York, 1922. D. Appleton & Co.)

Vaginal ligation of the aberrant ureter, according to Sargent,[175] has been done six times with four failures. Two of these failures were in his own patient, whom he later cured by implanting the lower end of the ureter into the bladder, drawing it into the bladder through a vaginal cystotomy by means of a hemostat inserted through the urethra. I have found one other case of vaginal ligation, that of McKay,[148,149] which was also a failure, but the patient was later cured by resection of the upper pole of the kidney.

Aside from nephrectomy and heminephrectomy the only method of treatment which has met with complete success in every case in which it has been used is abdominal ligation and resection of the aberrant ureter. This method, however, has been neglected and even condemned as a bad surgical principle. In the presence of infection or when the ureter drains an appreciable amount of functioning kidney these objections are, of course, sound, but when there is no infection and there is evidence that the kidney substance drained by the truant ureter was not only originally small, but has already undergone some atrophy from partial obstruction below, the method offers an entirely safe method of cure, and at the same time subjects the

patient to the surgical procedure of the least magnitude of any of those offering the same probability of satisfactory result. This contention is borne out by eight patients treated in this way, all with entirely satisfactory results.

2. *Incontinence Due to Trauma or Disease: (a) Stress Incontinence.* The commonest form of incontinence is that due to weakening or relaxation of the urethral sphincter mechanism, most frequently resulting from obstetric traumas and occurring usually in association with coughing, sneezing, laughing and so on, so that it has often been referred to as stress incontinence. Dr. Howard A. Kelly[120] in 1913, described this condition so accurately and suggested such a satisfactory method for its correction that I shall quote directly from his original article.

"There is a peculiar form of incontinence of urine in women which either follows childbirth or comes on about middle age, and is not associated with any visible lesion of the urinary tract. Sometimes the most suggestive picture that can be seen by a cystoscope is a gaping internal sphincter orifice which closes sluggishly. In the incontinence which comes on at about 40 years or over the patient usually first notices the occasional escape of a few drops of urine as she makes some unusual exertion. This grows worse until, at last, a little urine runs out whenever she coughs, laughs, sneezes, or lifts anything or steps up high. The condition may finally become so bad that the underclothes are constantly wet and soiled with the malodorous secretions.

"For a long time surgeons have tried to relieve this condition by a variety of operations, some of them more or less bizarre, designed to act upon the external urethral orifice by contracting it, or to resect the vagina at the internal orifice, or to kink the urethra, or in one way or another to compress it. These operations rarely succeed. I have seen many patients subjected to them, but none relieved.

"The key to successful treatment lies at the internal orifice of the urethra and in the sphincter muscle which controls the canal at this point. For the past 10 or 12 years I have been operating constantly upon patients suffering from this minor distressing inconvenience and I have succeeded in relieving every case where there had not been a destruction of the tissues at the urethral orifice, that is, where there had been no vesicovaginal fistula with sloughing.

"The operation which I do is as follows: A Pesser catheter is introduced into the urethra; the tube ought to be small, not over 5 mm. in diameter. With the patient in the lithotomy position, the posterior wall of the vagina is retracted and the area at the neck of the bladder is brought down with either forceps or four guy sutures.
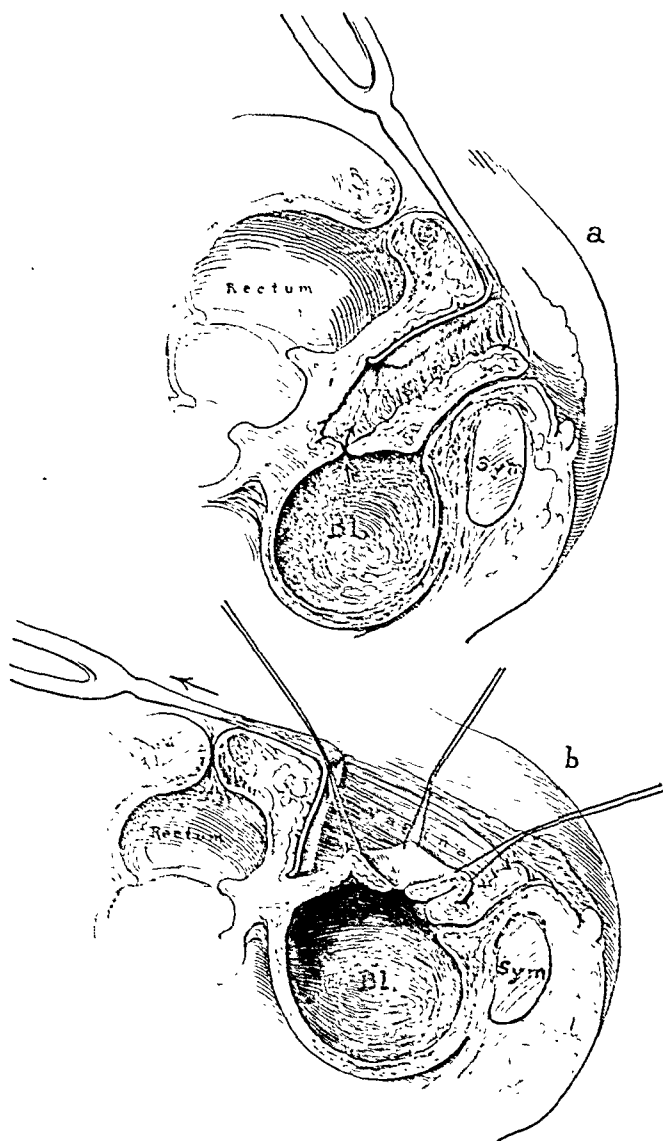
FIG. 17. Exposure of a difficult vesicovaginal fistula
following hysterectomy. *a*, patient in Sims posture, with
a strong retractor introduced into the vagina. *b*, the
perineum and posterior vaginal wall are drawn force-
fully out of the way, and the anterior vaginal wall is
drawn outward by means of guy sutures. (From Kelly
and Burnam. Diseases of the Kidneys, Ureters, and
Bladder. New York, 1922. D. Appleton & Co.)

"The next step is to slit the vaginal wall down to the urethra and the bladder in the median line for about 1½ or 2 inches. The neck of the bladder should fall at about the center of the incision. The position of the neck is

a   b
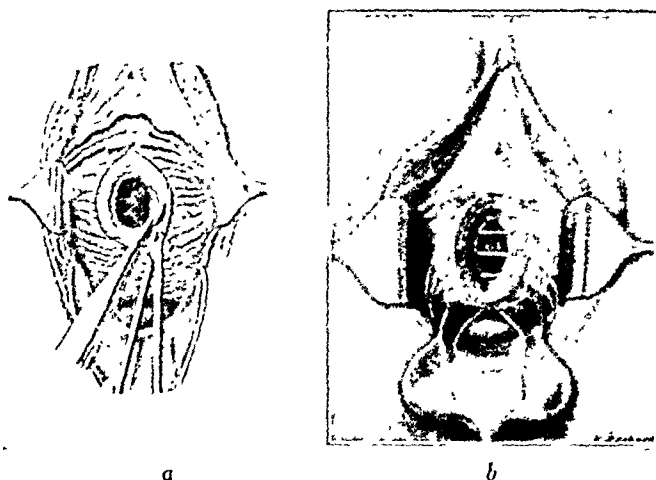
Fig. 18. Closure of a vesicovaginal fistula by the classical method of Sims. a, paring the edges of the fistula. b, the sutures placed. Sims used fine silver wire as a suture material and this is still the choice of many surgeons. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

easily determined at all times by moving the catheter to and fro, and feeling its head, which presses close up against the urethra. The utmost care should be taken not to cut into the urethra or the bladder at any step of the operation. After making this median incision the vagina is further dissected off on both sides with tissue forceps and dissected away for a distance of 2 to 2½ cms. around the neck of the bladder. This dissection may be made with blunt pointed scissors which push their way into the tissues, separate the bladder from the vaginal walls, and then cut the connecting fibrils. The dissection should be deepest at the neck of the bladder.

"When the detachment of the vagina from the bladder is completed, the finger should be able to grasp at least one-half or two-thirds of the neck of the bladder including the contiguous urethra. Sometimes the bladder wall is so thin that its mucosa shines through.

"The next step is to suture together the torn or relaxed tissues at the neck of the bladder, using 2 or 3 mattress sutures of fine silk or linen passed from side to side. The first suture, taking in about 1½ cms. of tissue, is tied at once, when the succeeding suture may be passed outside this, further contracting and bringing together the tissues at the neck. This is the principal part of the operation, and when done the mushroom catheter ought to be pulled out, the head of the catheter escaping with a little jump

as it clears the tightened reconstructed sphincter at the neck of the bladder. The more or less redundant vaginal walls, which have been detached in order to expose the sphincter area, are now resected so that the remaining tissues can be snugly brought together from side to side, so as to support the vesical area operated upon and avoid any dead space between bladder and vagina. I prefer to do this suturing with a continuous fine catgut suture in one or two layers."

Those of us trained in Kelly's clinic, and many others, have found that this procedure gives almost universally satisfactory results if limited to the type of case for which it was intended. If applied to cases in which the defective sphincter mechanism results from improper or defective innervation, failure is almost certain to result. Recent investigations along the lines of cystometry and roentgeno-graphic studies of the urethra have resulted in valuable additions to our means of determining more accurately the exact nature of the incontinence in each case, and therefore enable us better to determine the best lines of treatment. As stated by Barnes,[5] "stress" incontinence may result from an increase in urinary expulsive force or intravesical pressure, a lowering of the powers of resistance of urethral sphincter action, or a combination of both of these factors. Cystometric studies are especially helpful in determining the presence and the degree of the first of these factors, while urethrograms properly made and interpreted give much information as to the second. Kennedy[123] has devised an elaborate instrument for the taking of urethrograms, the principle of which has been simplified by Barnes,[5] so that a balloon made of two finger cots is connected with a reservoir of strong sodium iodide by means of which the pressure within the balloon can be varied. The bladder is filled with 180 cc. of weak (8 per cent) sodium iodide solution after which the balloon is placed in the urethra. With the pressure in the balloon at 35 cm. of water weakness in the urethral sphincters is demonstrated by their inability to compress the balloon as shown in the x-ray. By varying the pressure the exact strength of different portions of the sphincter can be determined. If there is a marked increase in the intravesical pressure with normal urethrogram, the cause of the increased pressure should be sought for and corrected. Such a condition often occurs in the last trimester of pregnancy as a result of pressure upon the bladder from the pregnant uterus, and the same situation may be simulated by large pelvic tumors. Barnes[5] has further shown that in cases of descensus of the uterus cystometric studies show an in-

creased intravesical pressure which tends to disappear when the prolapsed uterus is replaced. The intravesical pressure may also be raised by large rectoceles pressing against the bladder. Disturbances
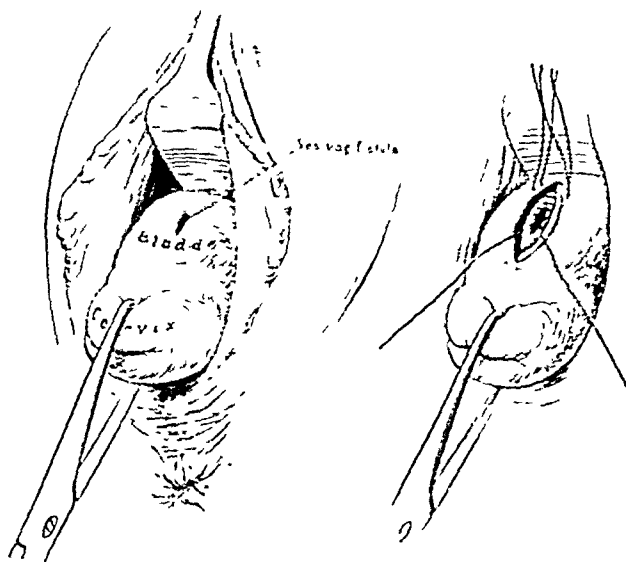
Fig. 19. Closure of a vesicovaginal fistula with dissection of the vaginal wall from the bladder and suturing in two layers. Procedure rendered quite simple by the fact that the cervix and the anterior vaginal wall can be drawn almost out of the vaginal introitus. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

of the motor innervation of the bladder musculature such as result from spina bifida occulta and multiple sclerosis often lead to such spastic contractions of the bladder as to produce incontinence. Reflex irritability of the bladder as a result of irritable ureters resulting from stricture not infrequently causes urgency to the point of incontinence. Indeed Hunner,[77] after an experience with about 750 patients suffering from incontinence, believes that this is probably the most frequent of all causes of this complaint in women, and that the first procedure in searching for the cause of incontinence should consist of examining the ureters for strictures. His experience has been that if strictures are found their thorough dilatation will often result in relief of the incontinence without further procedures; but that if this should fail to be the case, the improved health of the patient resulting from the adequate renal drainage renders her a more suitable subject for the necessary operative procedures. He has

particularly emphasized the probability of ureteritis of focal infection origin as the most likely cause of incontinence in those patients who only experience the symptom intermittently. In all cases due to intravesical tension surgical procedures upon the urethral sphincters are not apt to relieve incontinence, unless at the same time the causes of increased intravesical pressure are removed, and if indeed the urethrogram has shown no evidence of sphincter weakeess, the correction of the cause of intravesical pressure should be all that is necessary.

When there is sphincter weakness, there seems to be considerable difference of opinion as to which sphincter is most often involved, and therefore as to the best method of surgical approach. Kelly's operation is based on the hypothesis that the important weakness is in the vesical or involuntary sphincter, while H. W. Johnson[105] believes that the most important factor is a tearing or thinning of the external sphincter. His operation carries the plication further down along the urethra in an attempt to locate definitely and bring together the separated ends of the external sphincter. E. L. Young[222] in a very satisfactory article on the subject has divided the cases of obstetric origin into two groups. In the first group the patients are usually young and the onset of the incontinence is sudden and is noticed within a period of a week to several months following delivery. In these the incontinence is severe and often complete. At operation the separated ends of the external sphincter can be found retracted laterally and can be brought together by mattress sutures and reunited beneath the urethra. In the second group, which corresponds more closely to that described by Kelly, the patients are older, the onset of incontinence has been more gradual and the amount of the incontinence is usually much less. He believes that in this group there is a gradual relaxation of all sphincter muscles without tearing, and that the operation should consist of a tightening of the vesical neck after the method of Kelly, which should then be reinforced by bringing together the strong lateral portions of the suburethral muscle and fascia (extrinsic sphincter). The author's personal opinion is that Kelly's operation automatically accomplishes this in the vaginal closure, particularly if this is done in two layers.

Kennedy's[122,123] theory of the cause of incontinence of this type is considerably more elaborate than that of most other investigators. He believes that both internal and external sphincters are involved,

but that the involvement of the internal sphincter is not due to weakness but to distortion and interference with symmetrical closure as a result of adhesions formed in the tissues between the vesical neck and
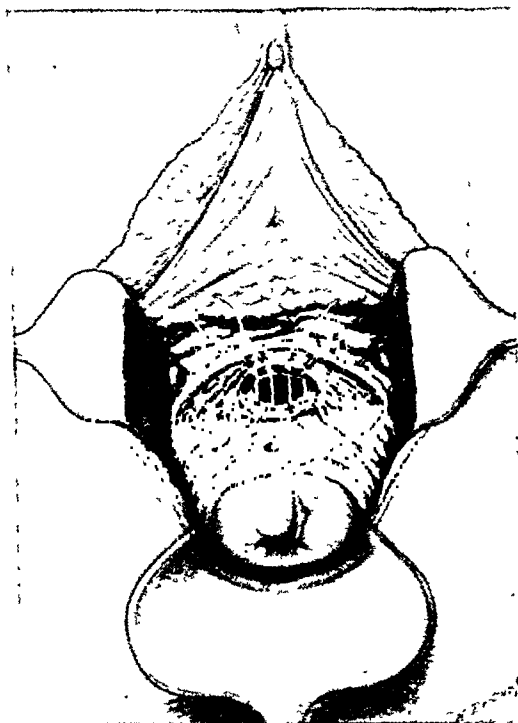
Fig. 20. Closure of a vesico-uterine fistula from below. The sutures closing the denuded and mobilized bladder are in place, ready to tie. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

the symphysis pubis. He, therefore, advocates an operative procedure which begins with a complete disection around the vesical neck and upper urethra to break up these adhesions. After this the suburethral tissues are plicated in the midline to strengthen the torn or attenuated external sphincter. He reports complete success in twenty-six of twenty-eight patients treated by this method, five of whom previously had been treated unsuccessfully by other methods. To the author, in view of the degree of success achieved by many competent surgeons with the Kelly type of plication of the vesical sphincter and careful reconstruction of the suburethral supporting tissues, the wide dissection for freeing of supposed prevesical and

preurethral adhesions seems not only unnecessary but also somewhat hazardous.

Taylor and Watt[197] among others have emphasized the fact that with cystocele and prolapse the dragging of the prolapsed posterior part of the bladder neck upon the sphincter tends to hold it open. It is, therefore, of primary importance that, in addition to whatever operative procedure is done for sphincter weakness, any prolapse or cystocele should at the same time be carefully corrected. Davies[31] believes that the levator ani and bulbocavernosus muscles also play an important part in strengthening and assisting the action of the external sphincter. He recommends a firm plication of all the tissues of the anterior vaginal wall from the urethral meatus to the cervix, after which a perineorrhaphy should be done in which the denudation should be carried sufficiently far forward to permit actual identification and resuturing into the perineal body of the retracted ends of the bulbocavernosus muscles.

In summary, an analysis of the rather extensive literature upon this subject, of which only a few representative articles have been referred to, leads to the following conclusions:

First, that urinary incontinence occurs frequently in the presence of an intact urethral tube, and that such incontinence may vary from the loss of only a few drops of urine on sudden increases of intra-abdominal or intravesical pressure (stress incontinence) to the complete inability to control the escape of urine from the bladder.

Secondly, such incontinence may be the result of increased intravesical pressure, weakness or absence of sphincter activity, or a combination of the two.

Thirdly, that an accurate diagnosis as to the degree to which each of these factors enters into the causation of the incontinence is essential to the undertaking of successful treatment.

Fourthly, that cystoscopic and urethroscopic examinations, cystometry and urethrography are all helpful in establishing such a diagnosis.

Fifthly, that having eliminated increased intravesical pressure as a factor, or having found it and corrected its cause, the attack upon the urethra should depend upon the amount of incontinence and the degree of sphincter weakness as demonstrated by urethrograms. Where the incontinence is slight or of moderate degree, and where the urethrogram shows only a moderate funnel-shaped dilatation at the vesical orifice, a Kelly plication is usually adequate. When the

dilatation extends lower into the urethra, more careful attention to restoration of the external sphincter is required. In those cases in which the whole urethra appears dilated under low pressure, particularly if there is reason to believe that the defect is due to lack of normal nerve control, some type of muscle transplant is necessary for the restoration of continence.

b. *Destruction or Absence of the Urethra.* Destruction or absence of the urethra occurs rarely and may result from several causes. Complete hypospadias should be classed in this group, but as pointed out by Cecil[15] in a careful analysis of forty-seven supposed such cases collected from the literature, it is not always possible to be sure whether the condition originated as a congenital defect or was acquired later through some other cause. In the acquired cases the defect most often results from obstetric traumas, either a sloughing of the urethra as a result of prolonged compression between the head of the child and the symphysis pubis, or less frequently the urethra may be torn away by misplaced forceps. A third cause is surgical destruction of the urethra, either intentionally as in the radical resection for carcinoma, or accidentally as in the cases cited by Kelly and Noble.[118] Ulcerative lesions particularly lymphopathea venereum may finally result in such complete destruction of the urethra, and the author has seen at least three such cases.

In these cases there is always a fistulous opening into the bladder in the region of the vesical neck, and there may or may not be some vestiges of the anterior and lateral urethral walls. Occasionally a short portion of the external end of the urethra may remain intact as in cases reported by Cecil[15] and by Ward.[213,214] Regardless of the etiology and of the presence or absence of urethral remnants, the distressing symptom of total incontinence of urine is always present and treatment should be directed toward its alleviation.

In attempting to reconstruct the urethra several plastic procedures have been devised and used with some success, although the variety of such procedures that have been recommended is probably the best evidence that none of them have achieved a very high percentage of satisfactory results. The original etiology, the previous attempts at repair, and the condition of the tissues as to scarring and blood supply, are all factors which play a part in determining the eventual outcome. All too frequently operation has resulted in the reconstruction of a semblance of an urethral tube, but without improvement in urinary control because of complete absence of any

sphincter mechanism in the new urethra. If the tube itself can be satisfactorily restored, however, control may be achieved at a second operation by transplantation of muscle strips, utilizing the levator ani muscles as recommended by Douglas,[37] the gracilis as described by Deming,[36] or the pyramidalis together with strips of rectus fascia as described by Goebel[53] and Stoeckel[195] and later modified by Miller[155] and also TeLinde.[199]

To reconstruct the urethral tube Noble[118] utilized the left labium minor. Kelly[118] made a tunnel beneath the mucosa behind the symphysis extending from just behind the base of the clitoris to the anterior margin of the defect in the bladder. Through this tunnel he pulled a flap of similar length turned down from the anterior vaginal wall above the fistula. This gave an immediate mucosal lining to only the posterior half of the new formed tube. Ward[213] at the suggestion of Farrar, McGlinn,[147] and very recently Geist,[51] making use of a similar tunnel have turned down a much wider flap from the anterior vaginal wall, the free margins of which were then sutured together over a catheter to form a complete mucosa lined tube which was pulled through the tunnel. Ward in 1934,[214] varied the technic by laying the tube into a trough between mucosal flaps at the normal site of the urethra. These methods have given much more satisfactory results so far as continence is concerned than any other not making use of muscle transplants. The more favorable results are very probably due to the fact that in closing the defect in the anterior vaginal wall from which the wide flap has been turned down, an opportunity is offered for drawing snugly together the supporting tissues beneath the vesical neck, which may be done in a manner similar to Kelly's plication of the vesical sphincter. The author has recently treated two patients by this method in both of whom the defect resulted from lymphopathea venereum. Probably because of the scarred and ischemic condition of the tissues, the reconstructed urethra sloughed in each case, but despite this fact the incontinence was greatly improved as a result of the tightening of the vesical neck. Cecil[15] rolled up a tube of mucosa from behind the symphysis which he attached around the opening into the bladder. This tube remained attached to its original site anteriorly throughout its entire length, thus leaving more of the original blood supply. Taussig[196] in 1918, described a procedure in which a band of muscle from the left levator was transplanted to give sphincter action for a reconstructed urethra, and Douglas[37] more recently in a two-stage operation first

turned down a flap from the anterior vaginal wall which he sutured into slits extending downward from the bladder opening. The lower portion of the tube thus formed sloughed, but enough remained so

FIG. 21 Treatment of vesico-uterine fistula by abdominal incision. The vesico-uterine fold of peritoneum (p-p) is divided and the fistula (f) exposed and detached from the uterus (von Dittel). (From Kelly and Burnam Diseases of the Kidneys, Ureters, and Bladder New York, 1922 D Appleton & Co.)

that at the second operation he was able to transplant strips of the levator ani muscles around it. The urethra was then again lengthened below this new formed sphincter by pulling a flap through a tunnel as originally done by Kelly. Three patients treated in this way all acquired complete control. With all of these methods it is advised that a catheter be left extending through the reconstructed urethra into the bladder for several days. Crossen[25] in the immediate reconstruction of the urethra after resection for carcinoma, tightened the vesical neck, and reconstructed the tube from vaginal flaps. He drained the bladder through a vaginal cystotomy as he believed that the presence of a catheter in the operative field might militate against satisfactory healing. His efforts were rewarded with success in three cases. This procedure is worthy of more serious consideration than it has generally received.

c. *Urinary Fistulae.* Urinary fistulae, because of the deplorable condition to which they reduce the patient, and the many obstacles to successful cure which they often present, have commanded a considerable share of the gynecologic literature of the past century.

These fistulae may be conveniently classified as follows: (1) vesi-covaginal; (2) vesico-uterine; (3) other vesical fistulae such as vesico-intestinal and vesico-abdominal; (4) urethrovaginal; (5) vesico-urethrovaginal involving the vesical neck and internal sphincter; (6) ureterovaginal; (7) ureterocervical; (8) other ureteral fistulae. Classes 3 and 8 of this group are extremely rare and are common to both sexes so that they will not be treated further here.

Vesicovaginal fistulae have long been a subject of particular interest to American gynecologists because of the impetus which the work of J. Marion Sims[185] upon this hitherto therapeutically baffling condition gave to our speciality. Comprehensive historical reviews of this subject have been published in 1906 and 1912 by Kelly[117,119] and in 1935 by Normal Miller,[156] and the interested reader may refer to these articles for a review of the subject as well as for complete bibliography.

Etiologically the fistulae may result from several causes. Until recent years the commonest cause was obstetric mismanagement. While occasionally a fistula resulted from a tearing into the bladder as a result of the improper application of forceps, much more frequently an unduly prolonged second stage of labor, during which tissues of the vesicovaginal septum lay incarcerated between the head of the child and the symphysis pubis, resulted in ischemia and necrosis with fistula formation. While the widespread improvement in obstetric practice has greatly reduced the incidence of fistulae from such causes, in recent years the increase in volume of gynecologic surgery and in the use of irradiation as a therapeutic agent in gynecologic surgery and in the use of irradiation as a therapeutic agent in gynecologic disorders has given rise to new etiologic factors. Complete hysterectomy, whether done by the abdominal or vaginal route, is the operation most frequently responsible for the production of fistulae, while the application of a radium plaque against the cervix in the treatment of carcinoma also not infrequently leads to a similar result. In the former instances the fistulae result usually either from a cutting or tearing into the bladder, or from strangulation of a portion of the bladder wall within a suture, which later leads to sloughing. In those cases resulting from irradiation the fistula may appear months or even years after the treatment, and as pointed out by Dean[34,35] it is usually preceded by a sloughing, bleeding ulcer within the bladder. Fistulae, then, resulting from any of these causes usually represent the completely devitalized sloughing central portion of a

much larger zone of ischemic tissue, a fact of very great importance
in the determination of therapeutic procedures. Among other causes
which may produce fistulae are necrosis from a neglected pessary,
vaginal ulcerations such as from a broken down gumma, and exten-
sive cervical carcinoma.

Symptoms. While the symptom of major importance, once the
fistula is established, is that of urinary incontinence, there are often
certain prodromal symptoms which intervene between the initial
trauma and the final completion of the sloughing process with the
establishment of the fistula. These symptoms usually consist of
marked frequency, urgency and dysuria suggesting a severe cystitis,
and often examination of the urine will reveal blood and pus. In the
cases resulting from obstetric or operative traumas these symptoms
usually last only a few days, after which the fistula is established and
incontinence appears, while in the cases resulting from irradiation
such symptoms may extend over several months, during which time
painful ulcerations which tend to bleed and which are covered with
grayish necrotic slough may be seen in the bladder base. Such lesions
have been described by Dean[34,35] as the tertiary reaction of the
bladder to irradiation. The author has observed several patients of
this type, who during the ulcerative phase suffered a severe systemic
reaction with fever, malaise, loss of weight and a general downhill
course suggesting a rapid progress of carcinoma, although examina-
tion disclosed no evidence that this was the case. In each of these
cases when the fistula became established a rapid improvement in
the general condition set in immediately. Such a reaction, it would
seem, can best be explained as resulting from absorption of toxins
from the tissues undergoing necrosis.

After the fistula has become established, in addition to incon-
tinence, the patient usually suffers from other symptoms resulting
from the reaction of the vaginal mucous membrane and the skin of
the vulva and thighs to the ever present urine. The vaginal mucous
membrane may become irritated and inflamed and often is encrusted
with urinary salts. The skin becomes red and scalded in appearance
and not infrequently a localized furunculosis may result.

Diagnosis. While the diagnosis of large fistulae presents no
problem, the very small ones must be differentiated from incon-
tinence due to impaired sphincter mechanism on the one hand, and
from ureterovaginal fistulae on the other. In the first instance, if
with the bladder full there is no visible spurting of urine from the

urethra on straining, while at the same time urine continues to accumulate in the vagina, the presence of a fistula is established. To differentiate a small vesicovaginal fistula from an ureterovaginal
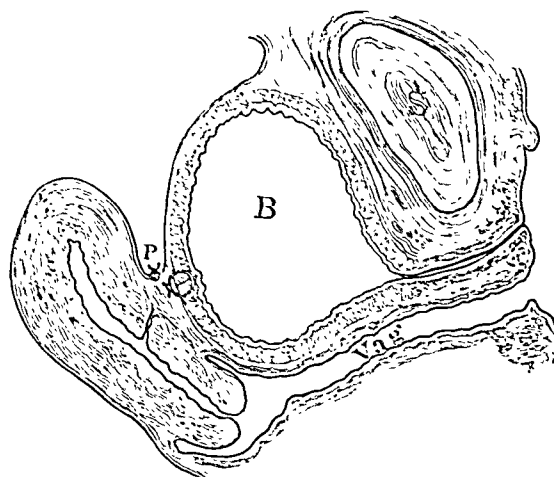
FIG. 22. Vesico-uterine fistula closed by operation from above. The hole in the bladder is now sewed up and then the vesico-uterine plica (P) is restored. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

fistula a gauze sponge should be placed in the vagina and the bladder filled with a solution containing methylene blue. If the sponge becomes stained with the blue solution, the presence of a communication between bladder and vagina is established; while if the urine which wets the sponge contains no dye, it must have come from the ureter.

In the study of a patient in contemplation of a repair of a fistula there are many points which must be carefully determined beyond its mere presence. From the vaginal side one should determine carefully the condition of the vaginal tissues, and all factors having a possible influence upon exposure for operation, such as the position of the fistula, the degree of relaxation of the introitus, and the degree of mobility or fixation of the cervix and anterior vaginal wall. The bladder should be carefully examined cystoscopically to determine the location of the fistula with reference to the vesical orifice and sphincter and particularly with reference to the ureteral orifices. Such an examination is usually easily accomplished with the Kelly cystoscope and the patient in the knee chest position, although the author was recently amazed at an article by Duncan[38] of Brooklyn in

which it was recommended that the vaginal introitus be closed by a purse-string suture, so that the vagina and communicating bladder could be made to retain enough water to permit of satisfactory cystoscopic examination. It was gratifying, however, that in the discussion of this paper both Phaneuf[168] and Sears[181] called attention to the usefulness of the Kelly instrument, although the former seemed to be under the impression that for the past twenty-five years it had largely fallen into disuse. In the author's clinic at the Johns Hopkins Hospital the instrument is still used in the urologic examination and treatment of seventy-five to one hundred patients weekly, and with the rare exception in which some orthopedic deformity prevents the assumption of the knee chest position on the part of the patient, no other type of cystoscope is required. We have rarely encountered a patient with vesical fistula, in whom the bladder could not be sufficiently expanded by atmospheric pressure to permit the location and catheterization of the ureteral orifices. The examination should always include catheterization of the ureters with determination of the separate function of the kidneys and the taking of pyeloureterograms. The ischaemic process which has produced the fistula may have involved to a lesser extent that portion of the bladder wall containing the intravesical portions of the ureters, resulting in scarring and strictures with resulting damage to the kidneys. If this is found to be the case, systematic ureteral dilatations should be carried out as a part of the preoperative preparation of the patient.

Treatment. Most of the large volume of literature that has been published upon this subject has dealt primarily with treatment. To J. Marion Sims,[185] the credit is generally given of first developing a systematic plan of treatment which could be looked to with any probability of success, although it is true that success had been achieved previously in isolated cases by several surgeons, as was duly recognized by Sims himself. According to Miller,[156] contemporarily with or shortly after Sms many brilliant contributions were also made by Jobert, Wutzer, Simon, Brown, Emmet, Bozeman and others. The plan developed and minutely described by Sims consisted of: (1) careful preoperative preparation of the patient, (2) carefully devised instruments and positions by which to secure adequate exposure for operation, (3) a skillfully planned and executed technic of operation, and (4) meticulous postoperative care. The great advances that have taken place in surgical technic since the time of Sims have resulted in innovations and improvements in the plan and

technic of operation for fistula which are often useful, but which even now in some cases cannot be used to better advantage than his original operation. Aside from such improvements and modifications in operative technic, most of the other points in his original plan of treatment are as useful today as when first enunciated.

In preparation for operation the urine should be acidified by appropriate medication, (now ammonium chloride is usually preferred) and the vagina should be prepared by hot sitz baths and warm douches, which, if encrustations are present, should be mildly acid. Silver nitrate either pure or in strong solution should be applied to ulcerated areas. At least six months should elapse after the appearance of the fistula or after an unsuccessful attempt at closure before operation should be undertaken. This gives sufficient time for any inflammatory reaction to subside and for the tissues to assume as healthy a state as possible. Just before operation is begun, if the fistula is near the ureteral orifices, both ureters should be catheterized and the catheters left in place during the operation. This greatly facilitates avoiding suturing or otherwise injuring the ureters.

The success of operation depends greatly on adequate exposure. Sims used the knee-chest and the left lateral posture with hips elevated (Sims' posture). Today the lithotomy position is usually preferred, but each of these positions is at times useful in individual cases. There is no surgical condition which calls for greater individualization and modification of technic according to the merits of each case than does this one. If the introitus is small and the cervix or vaginal vault relatively fixed, exposure may be greatly improved by the use of Schuchardt[179] paravaginal incisions. In the case of some fistulae situated high in an immobile septum, the type that often follows abdominal panhysterectomy, a suprapubic transvesical approach as recommended by Trendelenburg,[209] Kelly,[115] Young[223] and others, or the transperitoneal approach as recommended by Kelly,[115,121] Danforth[29] and others may be used to advantage. The classical operation of Sims consists of carefully denuding the vaginal mucous membrane from the margins of the fistula, after which interrupted sutures of silver wire are placed through the whole thickness of the septum down to but not to include the bladder mucous membrane. The sutures should be tied securely but not too tightly and should be left in from ten days to two weeks. Such a procedure is useful where the density of scarring between the bladder and vagina is so great as to make wide separation unduly difficult. If the sutures

cannot be tied without too great tension, this may be eased by
counter incision through the vaginal portions of the septum at
appropriate distances from the fistula.
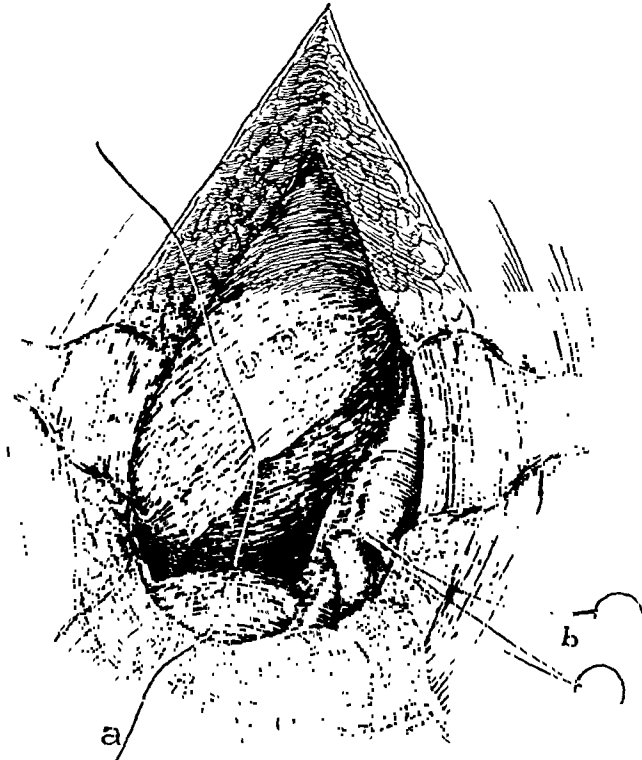
FIG. 23. Transperitoneal ureterovesical anastomosis. The
ureter was injured where it passed beneath the infundibulo-
pelvic ligament with resulting ureterocervical fistula. The
segment of ureter below the injury was densely strictured
and had to be sacrificed. Preliminary sutures: (a) for final
anchoring of bladder to sacral promontory; (b) for dragging
ureteral stump through the bladder opening and to act as a
stay suture. (From Hunner, G. L. and Everett, H. S.
J. A. M. A., 95: 327, 1930.)

Toward the end of the last century A. Martin,[145] Mackenrodt,[144]
and Kelly,[114] all independently suggested a wider denudation of the
margins of the fistula with separate closure of the bladder and vagina.
A further extension of this principle has been made so that now when
possible an attempt is usually made to separate the vagina from the
bladder well back from the margins of the fistula. The opening into
the bladder is then closed with one, or preferably two rows of inter-
rupted fine chromic catgut sutures none of which, however, should

penetrate the bladder mucosa. The second row should invert the first and the vaginal mucous membrane should be closed with interrupted silver wire sutures. If it is possible without too great tension, it is advantageous to shift the vaginal and bladder walls so that the line of suture of the vagina will not be over that of the bladder, or to have the two lines cross at right angles. If the fistula is of the vesico-uterine type, or if it lies close to the cervix, the bladder should be separated from the cervix as for an advancement operation for cystocele. After the openings in the bladder and uterus have been sutured, the bladder can then be advanced and reattached to the cervix so that the lines of closure will not be in approximation. If the fistula is of the vesico-urethrovaginal type an effort should be made to reunite the separated ends of the vesical sphincter. Failing in this incontinence will persist in spite of a successful closure of the fistula, but this may be alleviated later by some type of muscle transplant preferably of the Goebel-Stoeckel type. Urethrovaginal fistulae below an intact sphincter rarely give annoying symptoms. They may be closed by suturing over a catheter.

The above are general principles which can be modified to meet the requirements of most cases. Kelly and Burnam[121] have detailed the technic employed in a number of special types of cases and the interested reader may refer to that work. Many of the most recent articles on the subject have merely tended to emphasize in detail some particular point, such as a new method of preparation of the vagina, or of obtaining exposure, or a new suture material. While all of these suggestions are helpful and important, a detailed account of them is beyond the scope of this article. The achievement of success depends largely upon three factors: the careful preoperative preparation of the patient, the ability of the surgeon to vary the technic of operation according to the requirements of each case, and to carry out the steps of the operation with meticulous precision, and finally painstaking postoperative care.

The aim of the postoperative care should be to prevent distention of the bladder by urine, and as nearly as possible to prevent urine from remaining in contact with the operative field. To accomplish this a retention catheter should be left in the bladder for from ten days to two weeks. If the fistula is well removed from the vesical neck, a Pezzer catheter is most satisfactory; but when the operative field has approached close to this region, a plain male catheter held in by a suture is less apt to impinge upon the line of closure. If the vesical

neck has been involved, catheter drainage had best be accomplished through a vaginal cystotomy wound well above the region of the fistula. Such cystotomy wounds tend to close as soon as the catheter
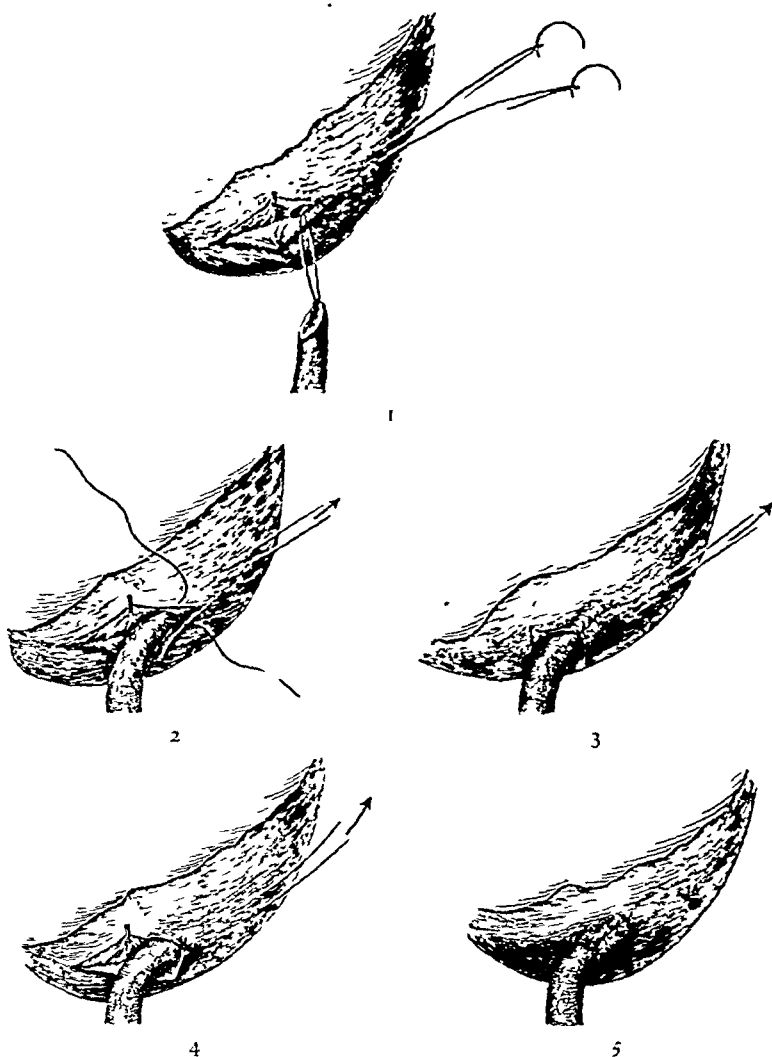
FIG. 24. Method of making the submucous ureterovesical anastomo-
sis. 2, 3 and 4 should show the stay suture as already tied. (From
Hunner and Everett. *J. A. M. A.*, 95: 327, 1930.)

is removed even without suture. Except in those cases where vaginal cystotomy is performed the suture line is best protected against urine during the early days of healing by having the patient remain in the prone position.

Ureterovaginal and Ureterocervical Fistulae. These fistulae are somewhat rarer than vesical fistulae and result usually from injury to one or both ureters during the course of gynecologic operations. The operations most frequently responsible are complete hysterectomy and those for removal of extensive adnexal inflammatory masses. Newell[161] in a study of 2,634 hysterectomies found injury to one or both ureters in fourteen of the cases. Patton[167] reported thirty cases of ureteral injury in a period of two years at Barnes Hospital, sixteen of which resulted in ureterovaginal fistulae. The operations had been complete hysterectomy (three for carcinoma) in eleven cases, and removal of diseased adnexae in four cases. The injury may be encountered in one of the following ways: (1) complete or marginal ligation of the ureter with subsequent sloughing; (2) crushing with forceps; (3) extensive stripping and interference with the blood supply followed by sloughing; (4) incision and partial division of the ureter; (5) complete division of the ureter, and (6) resection of a portion of the ureter.

Symptoms. The postoperative course of the patient in whom ureteral injury has occurred is usually stormy, but as the operations in which such accidents happen are usually of the most difficult type, such an eventuality is to be expected irrespective of ureteral injury. Of Patton's cases seven experienced renal pain without unusual fever, two unusual fever without renal pain, while in four neither of these symptoms was present. The type of postoperative course was not known in three who had been operated upon elsewhere. In ten patients in whom it was determined, the onset of urinary leakage varied from four to twenty-one days following operation. Unless there are fistulae from both ureters which is extremely rare, the leakage is generally described as continuous and uninfluenced by posture, while the patient also voids normally.

Diagnosis. These fistulae must be differentiated from very small vesicovaginal fistulae, and this can be done easily by instilling into the bladder a weak solution of methylene blue as described above. The side involved may be suspected from the difficulties of the operation and the opening into the vagina will usually be found on the side of the ureter involved, but neither of these rules can be safely relied upon as was true in a case cited by Kelly and Burnam.[121] In a case reported by Hunner and the author,[97] no particular difficulties had been encountered in the original operation, but an injury to the right ureter, as it passed beneath the infundibulopelvic ligament, resulted

in a fistula which established a channel within the broad ligament and drained through the cervix. Cystoscopic examination will usually reveal the orifice of the uninjured ureter spurting normally, while no
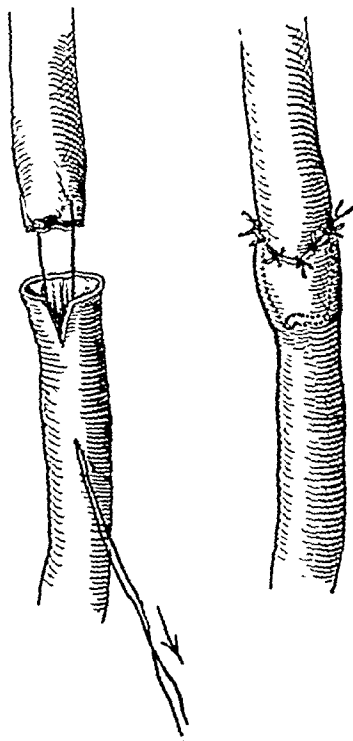
FIG. 25. End-to-end anastomosis of cut ureter. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.) If such anastomoses as well as ureterovesical anastomoses are performed over an ureteral catheter, free drainage is insured during the phase of postoperative edema.

urine can be seen coming from the orifice of the injured one. The normal ureter can be catheterized with ease, while an impassable stricture is usually encountered just below the fistula in the injured one.

Treatment. The surgical correction of ureteral fistulae is not easy and every care should be taken in performing gynecologic operations to avoid ureteral injury which may lead to occlusion or fistula. If such an injury occurs unavoidably and is recognized at the

time, repair should be undertaken at once. If the ureter has been severed but both ends are recognizable and intact, an end-to-end anastomosis should be performed over a catheter. If a portion of the lower segment has been removed, as may easily happen in removal of badly indurated inflammatory masses, the end of the upper segment should be reimplanted into the bladder. If this procedure is impossible because of the poor condition of the patient or the wide gap between the ureter and bladder, the ureter may be brought out through the abdominal wall or ligated. In Patton's[167] cases the interval between the original operation and the investigation for the purpose of treatment varied from sixteen days to six years. In the cases neglected for long periods before investigation, it is quite frequently found that severe or complete loss of renal function has occurred on the affected side. In such an event, if the function of the uninvolved kidney is normal or shows compensation for the loss of its mate, nephrectomy is the treatment of choice and of course relieves the incontinence. If the condition of the kidney warrants it, every effort should be made to save it. If, as is usually not the case, a catheter can be passed through the bladder into the ureter to a point beyond the fistula, the catheter should be left in place and occasionally the fistula will heal over it. If the ureter has been completely severed at operation, it is usually difficult to find the lower segment at the time of attempted repair. If the injury has not resulted in complete severing of the ureter, the lower segment is often so densely strictured as to offer insurmountable difficulties in dilating it originally and keeping it open subsequently, as was true of the case reported by Hunner and Everett.[97] The treatment of choice, therefore, usually is to reimplant the ureter into the bladder. Kelly and Burnam recommend that this be done when possible extraperitoneally through an incision about six inches long in the semilunar line directly over the pelvis. The ureter should be implanted as near the base of the bladder as possible to prevent future displacements of the ureterovesical orifice by the repeated filling of the bladder. The ureter should be led through the bladder wall diagonally, seeking to utilize the Coffey principle of leaving an ureterovesical valve. A large plain open end catheter, preferably a No. 9 or 10, should be introduced up to the region of the renal pelvis, and its lower end pushed out through the urethra. This makes the performance of the operation easier, it insures good renal drainage during the period of healing, and most important of all it splints the tissues of the uretero-

vesical region during the healing period and prevents the formation of obstructive angulations. If the kidney is already infected, frequent irrigations with a mild antiseptic solution may be given. As in the
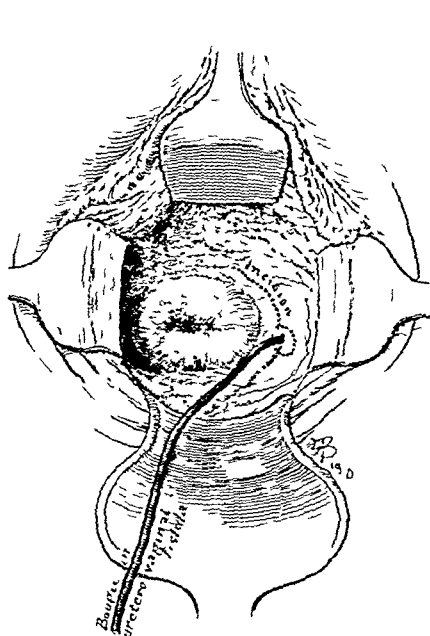
FIG. 26. Ureterovaginal fistula. I Catheter inserted in fistula. The dotted line shows the location of the incision for dissecting out the lower end of the ureter and implanting it into the bladder. (From Kelly and Burnam. Disease of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)
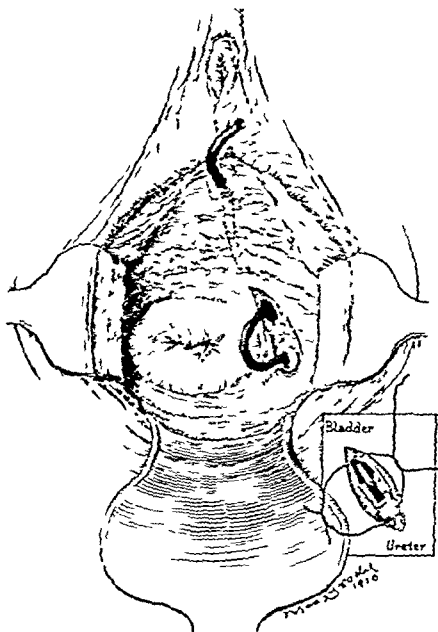
FIG. 27. Ureterovaginal fistula. II. The larger figure shows an opening in the bladder through which the free end of the catheter has been conducted and then brought out through the urethra by means of the open air speculum. The lower end of the ureter is dissected free for a little distance. It is then drawn into the bladder by means of traction sutures placed as in the smaller drawing. It is well to add another stitch or two to hold the ureter securely in place. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

case of any renal retention catheter, great care should be used to keep the bladder clean during the use of the indwelling renal catheter.

To facilitate the above operation it is well to first determine the lowest point in the bladder to which the ureter can be carried without undue tension. Then locate the position of the middle vesical artery coming up from the internal iliac so that the incision into the bladder will not molest this important blood supply. The bladder incision

should be generous, beginning in the vertex and running straight down the lateral or the posterior wall to the proposed site of anastomosis. If the functional end of the ureter is unduly short, one sometimes uses a portion of the bladder wall for a plastic lengthening of the area of anastomosis.

Patton[167] in one case drew the ureter back into the bladder through the stump of the lower ureteral segment, which he had dilated forcibly from within the bladder opened suprapubically. While this procedure has the advantage of reimplanting the ureter into the bladder at its normal site, it can be done only when the injury is very low, and even then is feasible only in those cases in which it is possible to dilate the lower segment adequately. Kelly and Burnam[121] have cited several methods of reinserting the lower end of the ureter (or ureters as in one case) through a vaginal approach, but again the application of these methods is strictly limited.

3. *Incontinence Due to Nervous System Lesions.* Disturbance of micturition due to neurological lesions occurs much more frequently in the male than in the female, 221 males to twenty-nine females in a series of 250 patients studied by Lendrum and Moersch.[138] This subject has been thoroughly covered recently in a book by Langworthy, Kolb, and Lewis,[135] and the interested reader may seek detailed information from that source. Briefly it may be stated that the effect upon the bladder is a result of the location of the neurological lesion and the nerve pathways affected rather than of the type of neurological disease. Lesions such as tabes dorsalis which affect the afferent sensory impulses from the bladder result in a loss of sensation of the desire to void, with resulting retention of urine which may eventually lead to enormous overdistention of the bladder and overflow or paradoxical incontinence. If a diagnosis is made before too great atrophy of the vesical musculature has resulted from over distention, the patient may be educated to try to empty the bladder at definite intervals in spite of the absence of desire. The tone of the bladder musculature may also be improved by the use of mecholyl bromide 0.2 gr. once or twice daily. When the motor innervation is affected as in some cases of spina-bifida occulta and multiple sclerosis, a spastic condition of the bladder musculature may result which is sufficient to produce an intravesical pressure greater than can be resisted by the urethral sphincters thus leading to incontinence. Such cases are often benefitted by the administration of tincture of belladonna and ephedrine sulfate in appropriate doses.

[64]

When there is entire absence of sphincter activity as was the case in a girl with spina-bifida reported by TeLinde,[109] some modification of the Goebel-Stoeckel type of procedure may be employed with success.
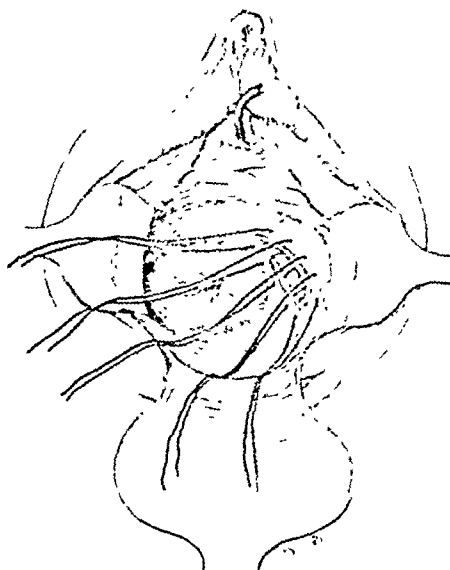
Fig. 28. Ureterovaginal fistula. iii. Final step of the operation shown in the preceding figures. Closure of the vaginal wall over the freed ureter by interrupted sutures. The ureteral catheter may be left in place with advantage for several days. (From Kelly and Burnam. Diseases of the Kidneys, Ureters, and Bladder. New York, 1922. D. Appleton & Co.)

4. *Ureterointestinal Anastomosis.*   In cases of exstrophy of the bladder and of traumatic defects of the urethra, bladder, or both in which the defects are of such extent that little hope can be entertained of successful plastic repair, resort may be had to transplantation of the ureters into the rectum. The history of the efforts of various investigators to find a reasonably safe and satisfactory method of accomplishing this purpose, beginning with Simon in 1851, and culminating with Coffey's[18] oblique submucous transplantation with inlying catheters has been reviewed thoroughly by Hunner and Massey[99] in 1930, and will not be repeated here. Later in operating upon small children for exstrophy of the bladder, Coffey[19, 20] abandoned the inlying catheters and substituted a method by which a

transfixion suture was passed through the ureteral wall and bowel mucosa, which in two or three days sloughed through establishing a communication between the ureter and the lumen of the bowel. With the earlier methods the operative mortality was unduly high and later complications numerous; and although many successful cases have been reported treated by the Coffey technics, subsequent recurring episodes of pyelitis and pyelonephritis are the rule rather than the exception, so that in contemplating the advisability of accepting such a procedure the patient is placed in the quandary of Hamlet as to "Whether it is better to bear those ills she has or to fly to others that she knows not of."

The gravest immediate danger is that of peritonitis from contamination when the bowel is opened; but although, with a reasonably meticulous technic a peritonitis of serious extent can usually be avoided, the inflammatory reaction in the bowel wall around the implanted segment of ureter, necessarily following the immediate opening of the bowel lumen at the time of the transplant, certainly must interfere with the proper subsequent function of this ureteral segment.

Thus the inflammatory reaction in and around the ureteral segment may result in a dense stricture or a rigidity of the wall which interferes with its normal peristalsis, and prevents the collapsibility essential for a valve like action to prevent regurgitation. Quite recently Jewett[102] has devised and carried out successfully on experimental animals a technic which obviates this difficulty. Although sufficient time has not yet elapsed to evaluate the late results of this procedure, the immediate result upon patients has been entirely satisfactory. Jewett has kindly consented to the reproduction of his illustrations, and his description of the technic is stated so clearly and concisely that it will be quoted in full:

"The implantation is made in 2 stages. At the first operation the abdomen is opened through a left rectus incision under ether anesthesia. The small intestines are packed off exposing the sigmoid and the ureters, which lie beneath the posterior peritoneum. The peritoneum over each ureter is incised and the opening enlarged above and below, so as to allow each ureter to be laid without tension or angulation along the corresponding antero-lateral side of the sigmoid for a distance of 5 cm. A longitudinal incision 5 cm. in length is then made through the muscularis on each side of the sigmoid along this line which has been selected for the site of implantation. With smooth forceps the incised edges of the muscularis are

picked up and gently peeled away from the underlying submucosa for about 1 cm. Each ureter is then laid in its bed upon the submucosa. The edges of the muscularis are approximated snugly over it with a continuous suture of
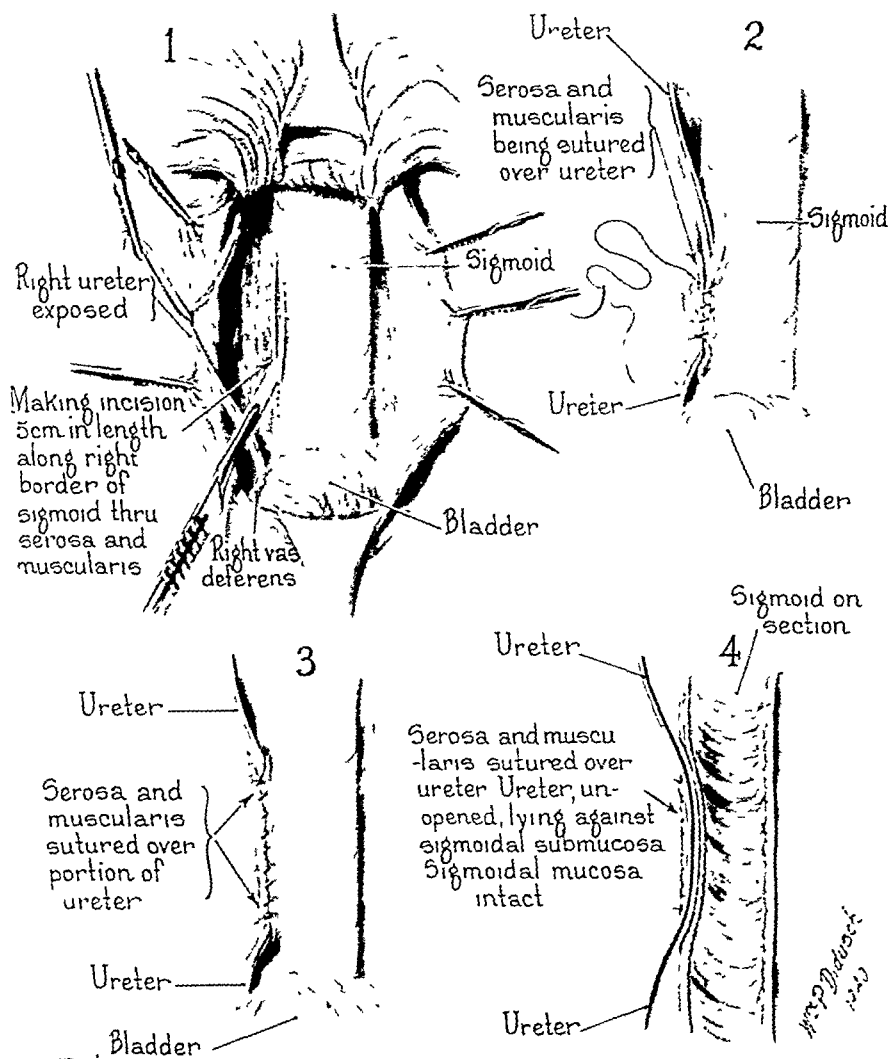
FIG. 29. Uretero-intestinal anastomosis, first stage. Ureters are laid in an aseptic bed without angulation, torsion or tension. Intramural periureteral fibrosis is reduced to a minimum, eliminating constriction and ensuring a collapsible valve. (From Jewett, H. J. J. Urol., 44: 223, 1940.)

fine black silk, care being taken not to compress the ureter, especially at its point of entrance. The packs are then removed, the omentum drawn down over the suture line, and the wound closed.

"Two weeks are allowed to elapse before the second operation. During this time the dog voids urine normally from the bladder and each incision

in the sigmoid heals over the implanted segment of the ureter with a minimum of scarring, because infection is entirely excluded. An efficiently functioning valve is thereby ensured.
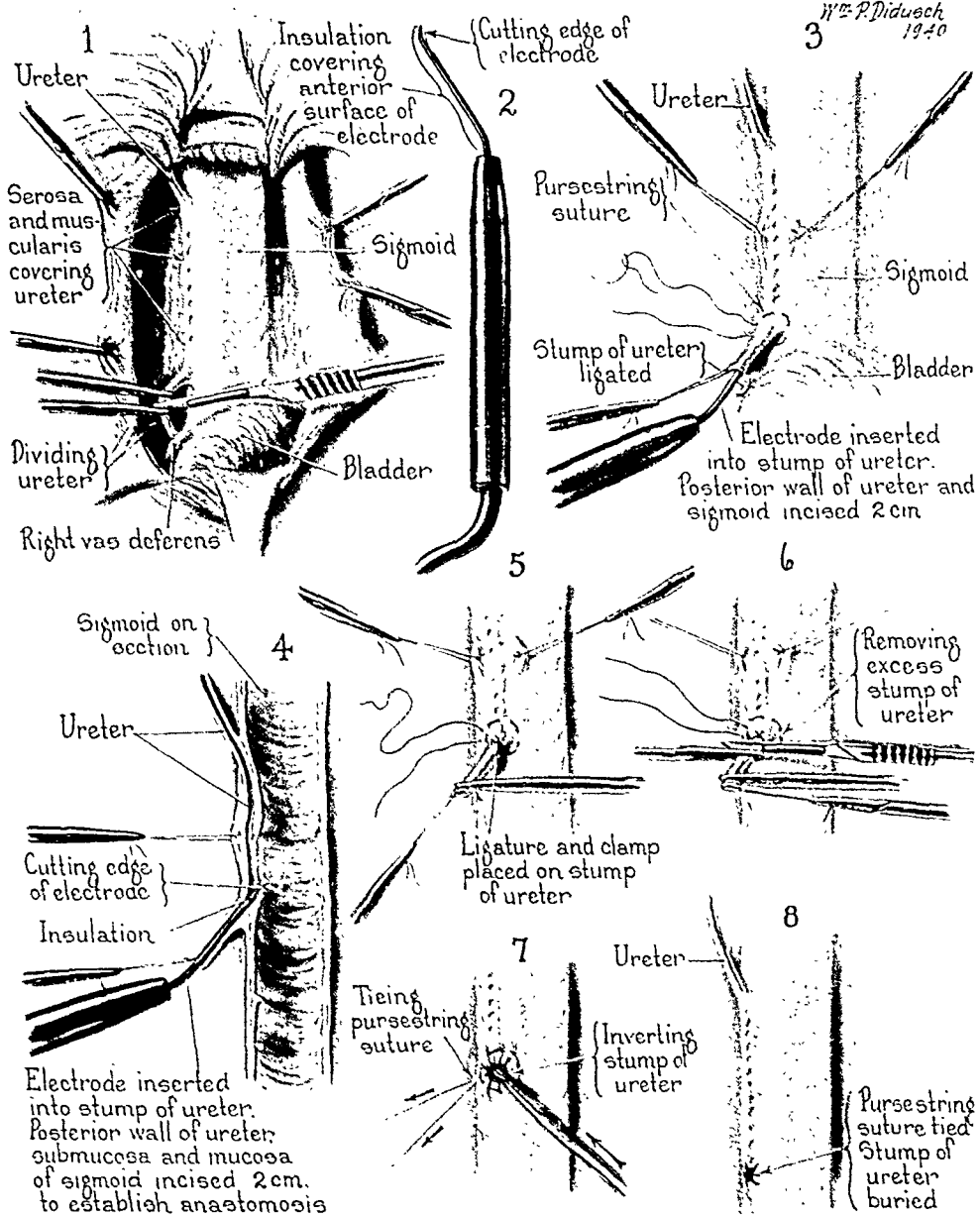
Fig. 30. Uretero-intestinal anastomosis, second stage (after two weeks.) Establishing a widely patent uretero-intestinal orifice. Its opposing margins do not reunite and constriction does not occur if anterior ureteral wall is shielded from cutting current by insulated electrode. There is no soiling. (From Jewett, H. J. J. Urol., 44: 223, 1940.)

"At the second operation the abdomen is opened through a midline or right rectus incision. Delicate adhesions between sigmoid and bladder or

small intestines are separated and the latter packed off. The ureter on each side is identified entering and emerging from its bed in the wall of the sigmoid. The left ureter is divided between clamps 2 cm. from its point of exit from the bowel, and the lower end ligated. A purse-string suture of fine black silk is placed in the wall of the bowel around the emerging ureter. Two traction sutures are inserted in the muscularis of the sigmoid on each side of the implanted ureter, half-way between its points of entrance and exit. Gauze packs are then placed around the base of the emerging ureter, the clamp is removed from its end, and a traction suture taken through its lip. The electrode, ingeniously constructed by Dr. Wilford A. Councill, is now inserted in the ureter and passed halfway up its intramural segment. Its tip is depressed while counter traction is afforded by the 2 traction sutures. The cutting current is then turned on and the blade of the knife is pushed into the lumen of the bowel and carried downward for a distance of 2 cm. The current is turned off, and as the knife is withdrawn a clamp is applied to the open end of the ureter. The emerging segment of the ureter is now amputated between a ligature, placed close to the bowel, and a second clamp. The stump is now inverted through the purse-string suture. The same procedure then is carried out on the right side, the omentum drawn down, and the wound closed.

"Ferguson (1931) first conceived the idea of establishing in cadavers a ureterosigmoidal ostium by means of a fulgurating needle passed up the lumen of the ureter. This procedure in a somewhat modified form was carried out on dogs by Douglass and Edwards (1936) who were unable to complete an anastomosis which remained competent. They observed also a high incidence of associated localized infection, and therefore abandoned the method.

"I cannot overemphasize the importance of applying the cutting current to only the posterior ureteral wall and the underlying intestinal submucosa and mucosa. A wide ureteral orifice is then obtained. If the anterior wall of the implanted portion of the ureter is allowed to be burned, the newly formed ureteral orifice becomes contracted, and the overlying bowel wall may become necrotic. Therefore, the electrode used in these experiments has been so designed that the insulation covers the entire anterior margin of the blade and thereby affords complete protection to the anterior ureteral wall."

In the occasional case with a marked prolapse of the uterus and a severe bladder and urethral defect, the ureters with buttons of bladder wall may be transplanted into the rectum transvaginally and extraperitoneally as was done in one case by Hunner.[96]

V. RETENTION OF URINE

Complete retention of urine or large amounts of residual urine are rare in the female except as a postoperative complication. As has

been discussed in some detail above urethral stricture of sufficiently small caliber to produce retention is rare, and the condition of fibrosis or contracture of the vesical neck requiring resection as emphasized

FIG. 31. Complete procidenture; vesicovaginal fistula, with prolapsing vesical mucosa and ureteral orifices; total absence of urethra; laceration through right labium minus with retraction of clitoris and prepuce toward left. (From Hunner, Guy L. *J. Urol.*, 39: 343, 1938.)

by Caulk must be even rarer. The treatment of such cases naturally consists in removal of the obstruction by dilatation of the stricture or resection of the contracted vesical neck. Retention of neurogenic origin such as is frequently found in patients afflicted with tabes dorsalis has been referred to previously. Patients suffering from various types of psychiatric conditions, particularly those of an hysterical type may often experience an inhibition of micturition, a fact which should be kept particularly in mind by gynecologists if they would avoid the embarrassment of mistaking a full bladder for a pregnant uterus or an ovarian cyst.

Other causes which may be cited as occasionally producing acute retention are a variety of conditions which may obstruct the urethra

by pressure from without. Among such conditions may be listed pelvic abscess, uterine myomas, suburethral abscess and diverticulum, and a few cases have been reported (Snodgrass,[188] Lazarus,[136] Mouradian[158]) of acute retention in girls of pubertal age resulting from imperforate hymen with hematocolpos. Two cases of acute retention complicating large uterine myomas have recently been observed by the author in a series of one hundred patients with various gynecologic conditions studied with particular reference to possible urologic complications. A few days ago a patient appeared in the clinic with acute retention, in whom pelvic examination revealed a retroverted uterus about ten weeks pregnant, in the anterior wall of which there was a myomatous nodule about 8 cm. in diameter. The *acute retention in this patient had developed when the patient* delayed voiding for some time after the desire had been first experienced. The distended bladder impinging upon the anterior surface of the enlarged retroverted uterus had caused further backward rotation of the fundus and consequent forward rotation of the cervix against the base of the urethra. The author has encountered one other similar case in which a spinster in her late forties had experienced several episodes of acute retention over a period of two years. In each instance the retention had followed a failure to relieve the desire to void when it was first experienced. The uterus was deeply retroverted and the tip of the cervix lay close to the vesical neck. The mechanics of the production of retention seemed evident, but it was difficult to explain why such episodes had not occurred earlier, until operation revealed a myomatous nodule in the anterior surface of the uterus which could not be felt on vaginal examination because of the extreme retroversion.

The treatment in such cases consists of relief of retention by catheterization and correction of the precipitating cause by appropriate measures. If infection of the bladder has occurred as a result of the retention, it should be treated by methods which will be discussed later in connection with the subject of inflammations of the bladder.

Of much more frequent occurrence than complete retention is the presence of varying amounts of residual urine in association with cystocele and uterine prolapse. In these cases there is usually no obstruction to the escape of urine from the bladder; but a considerable portion of the bladder hangs below the level of the vesical orifice, and the lack of support is so great that the bladder musculature is unable to expel the urine from this dependant sac. Occasionally acute

retention may occur as a complication of procidenture, but in such instances the patient usually can void following manual replacement of the prolapsed uterus. These patients with residual urine are
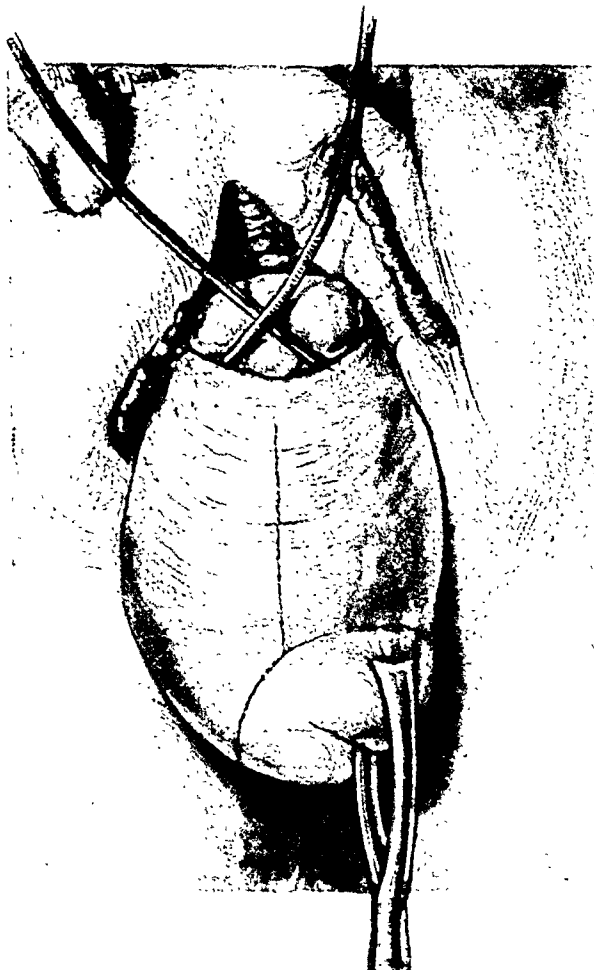
Fig. 32. Indwelling catheters introduced into ureters. Usual inverted "T" incision preliminary to vaginal hysterectomy. (From Hunner, Guy L. J. Urol., 39: 343, 1938.)

particularly subject to urinary tract infection. Six of fourteen patients with cystocele, or 43 per cent, in a series studied by Everett and Sturgis[13] showed infected bladder urine as compared with 26 per cent of such infection in the total group of one hundred patients suffering from a variety of gynecologic conditions. The incidence of retention following operations for these conditions is high, 58 per cent in a recent study reported by Woodruff and TeLinde,[221] so that it is highly important that every effort should be made to eradicate the infection before operation is undertaken. In order to do this the deformity should be temporarily corrected by means of a pessary.

The residual urine will thus be eliminated, and the infection will usually yield to some form of appropriate chemotherapy.

Retention of urine as a postoperative complication is very common following gynecologic surgery. Woodruff and TeLinde[221] found an incidence 51 per cent in a series of 257 pelvic laparotomies in a hospital in which no special measures had been taken to prevent retention, and an incidence of 58 per cent following vaginal plastic operations in each of two groups, one of fifty-seven patients in whom the same preventive measures had been employed as had achieved notable success in patients subjected to laparotomy, and a control group of sixty-two patients in whom no such measures had been used. Such retention also not infrequently follows parturition, particularly if the delivery has been operative.

As such retention greatly increases the liability of cystitis and adds to the patient's postoperative discomfort, every effort should be made to combat it. In 1925, a routine was adopted on the gynecologic service of the Johns Hopkins Hospital which has greatly reduced the incidence of postoperative retention. Before the patient leaves the operating table 30 cc. of 0.5 per cent aqueous solution of mercurochrome is instilled into the bladder, and a liter of 2 per cent sodium bicarbonate solution containing 60 cc. of liquid petrolatum are administered by rectum. This routine was instituted under the direction of R. G. Craig[24] who reported the early results and who believed that the mercurochrome caused a chemical irritation of the bladder resulting in an earlier desire to void, and that the rectal fluid resulted in a more rapid excretion of urine with an earlier filling of the bladder. Woodruff and TeLinde[221] have recently reported on 500 patients subjected to pelvic laparotomy treated in this way with an incidence of only 6.5 per cent who required catheterization, as compared with 51 per cent in a control series of 257 patients. They concluded that the bladder instillation was of primary importance rather than the rectal fluid, since in a series of fifty-four patients in whom the bladder had been instilled but the fluids omitted, only 5.6 per cent required catheterization. As evidence that the bladder was more completely emptied following this treatment than in the control series, it was found that the average time of the first voiding following operation was five and one-half hours, while in the control series it was nine and one-half hours. The average amount of the first voiding was 194 cc. as compared with 168 cc. after nearly twice the time in the control series. Postoperative urinary infection occurred in

only two of the 500 patients, and in both of these there was a history of such infection previously.

As stated above, no such decrease in the incidence of necessary
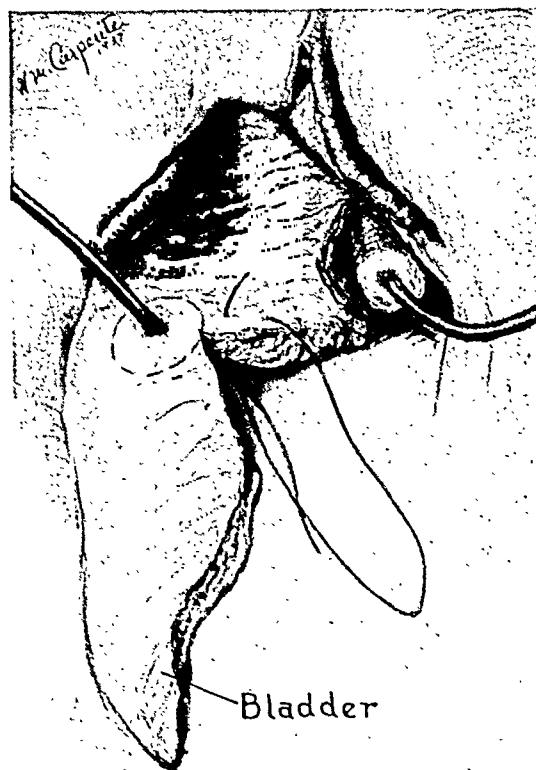
FIG. 33. Hysterectomy completed. Bladder bisected and left half already removed, leaving button of vesical mucosa about ureteral orifice. (From Hunner, Guy L. *J. Urol.*, 39: 343, 1938.)

catheterization was found to result from this treatment in patients subjected to vaginal plastic operations, and indeed it was found that following the Watkins interposition operation 72 per cent of the patients required catheterization. The authors, therefore, suggested the use of an indwelling male catheter in this type of case for the first week following operation. Kretzschmar and Brown[133] have also advocated the use of the indwelling catheter, connected with a reservoir of irrigating solution, in such a way that drainage or irrigation can be instituted as desired without change of apparatus. They suggest a 0.25 per cent solution of acetic acid as the irrigating fluid as this gives a pH of 3, considerably lower than can be tolerated by any of the usual offending organisms.

The advisability of the use of the indwelling catheter is open to question. The three objectives to be achieved in the treatment of

these cases are prevention of overdistention of the bladder, the prevention of residual urine and the prevention of infection. The first two of these objectives is certainly achieved by the indwelling catheter, but 25 per cent of the patients thus treated by Kretzschmar and Brown[133] developed infected urine, and figures pertaining to this are not stated by Woodruff and TeLinde.[221] Curtis[25] employing a routine of repeated catheterization, practically eliminated postoperative urinary infections in a large series of cases reported as long ago as 1918. In my own experience, which I believe agrees with that of Curtis, it is of primary importance that catheterizations be repeated frequently enough to prevent overdistention of the bladder, and that to achieve this the sensation of bladder fullness on the part of the patient should be used as an indication, rather than that catheterization be repeated after any certain number of hours. When after several catheterizations the patient begins to void, she will usually not be able to empty her bladder completely at first. It is, therefore, important that catheterization be continued at least once a day until only a very few cc. of residual urine are obtained. This rule should also be applied after the removal of an indwelling catheter. When repeated catheterization is necessary, or if an indwelling catheter is used 30 cc. of some mild antiseptic solution, 0.5 per cent mercurochrome or 1 : 1000 silver nitrate solution, should be instilled into the bladder once a day. When catheterization is required over a period of several days, or particularly if an indwelling catheter is used the oral administration of 6 to 12 Gm. of ammonium mandellate daily will often prove efficient as a prophylactic measure against infection. With the indwelling catheter the acidification of the urine, thus achieved, is often helpful in the prevention of encrustations and the clogging of the catheter by urinary sediment. If the reduction in residual urine appears unduly slow, it can often be hastened by the oral administration twice daily of 0.2 Gm. of mecholyl bromide (acetylbetamethylcholine bromide). Indeed this drug or doryl (carbaminolcholine chloride) may at times be effective in eliminating the necessity of catheterization or at least shortening the period over which it is required.

VI. DISEASES OF THE BLADDER

The bladder being an organ common to and essentially of the same character in both sexes, most of the diseases to which it is subject are of much the same character in both the male and female.

In the case of tuberculosis and primary neoplasms, this is true with regard to all aspects of the conditions, and these subjects are so adequately covered in all standard works on urology and the general
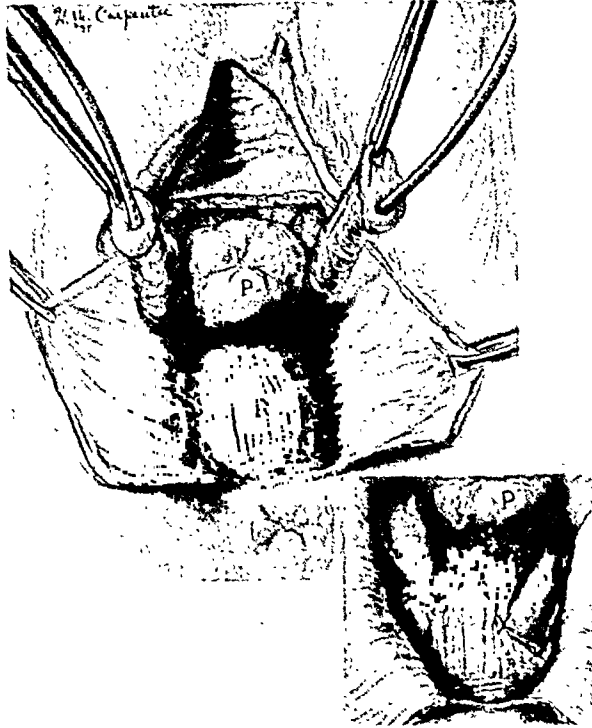
FIG. 34. Ureters have been mobilized; peritoneum has been closed with a purse-string suture which included round and utero-ovarian ligaments; posterior wall of vagina incised and drawn aside to expose anterior wall of rectum. Smaller insert: Ureterovesical buttons have been drawn into rectum and superficially placed fixation sutures of 40 day, No. oo catgut have been set. (From Hunner, Guy L. *J. Urol.*, 39: 343, 1938.)

literature, that no special treatment is called for in an article such as this, devoted to those features of urology peculiar to the female. Other conditions, however, particularly inflammations of the commoner bacterial varieties, as well as some special forms, and secondary neoplasms entail certain variations as to incidence, etiology, etc., which distinguish them somewhat in the female from similar conditions in the male, and therefore call for at least a brief consideration.

1. *Common Inflammations.* It is the author's impression that cystitis, or inflammation of the bladder, resulting from invasion by the more usual types of organisms, occurs considerably more frequently in the female than in the male. No accurate statistical data

upon this point has been found for adults, but among admissions to the Harriet Lane Home (The Pediatric Department of the Johns Hopkins Hospital) urinary tract infections have been noted nine times as frequently in girls as in boys. The most ready explanation of this fact seems to lie in the shortness of the female urethra, with its less efficient sphincter mechanism, and its meatus lying in a field constantly contaminated by colon bacilli and other offending organisms. If then some circumstances occur which tend to decrease the normally high resistance to infection of the bladder mucous membrane the basis of a cystitis is established. In the child such lowered resistance is probably usually the result of some systemic condition such as malnutrition, digestive disturbances or respiratory infections, but in the adult female pathologic processes in the neighboring genital organs frequently offer a more readily recognized cause of lowered resistance in the bladder. Ormond[165] states that autopsy studies show a low grade inflammatory reaction in the trigone of most female bladders, even though no clinical evidence of urinary tract disease may have been observed during life, and that similar lesions are usually not found at autopsy in the male. In a recent preoperative study of the urinary tracts of one hundred patients to determine the effects of various gynecologic conditions Everett and Sturgis[43] found infected bladder urine in 26 per cent. Among the various types of conditions the highest incidence of infected urine (35.3 per cent) was found in the group of seventeen patients with cystocele with or without varying degrees of prolapse of the uterus. In this group were four patients with complete procidentia in two of whom (50 per cent) the bladder urine was infected. A group of forty-seven patients with uterine myomas showed 30 per cent infected bladder urine, while surprisingly enough in twenty-eight patients with pelvic inflammatory disease, ranging from chronic salpingitis to pelvic abscess, the bladder urine was infected in only 14.3 per cent.

The bacteria which may be responsible for the production of cystitis and more extensive urinary tract infections commonly are members of the colon bacillus group and staphylococci, and less frequently, various forms of streptococci, enterococci, Bacillus pyocyanesis, Bacillus proteus, and gonococci. The bladder mucous membrane in its normal state is usually highly resistant to most of these organisms, as is evidenced by the rarity of infection following catheterization in order to obtain uncontaminated specimens of

urine, a common practice among gynecologists. It is true that such catheterizations are carried out with as nearly sterile technic as possible, but it is generally admitted that it is probably impossible to

Three hemorrhagic ulcers
surrounded by

Edematous area
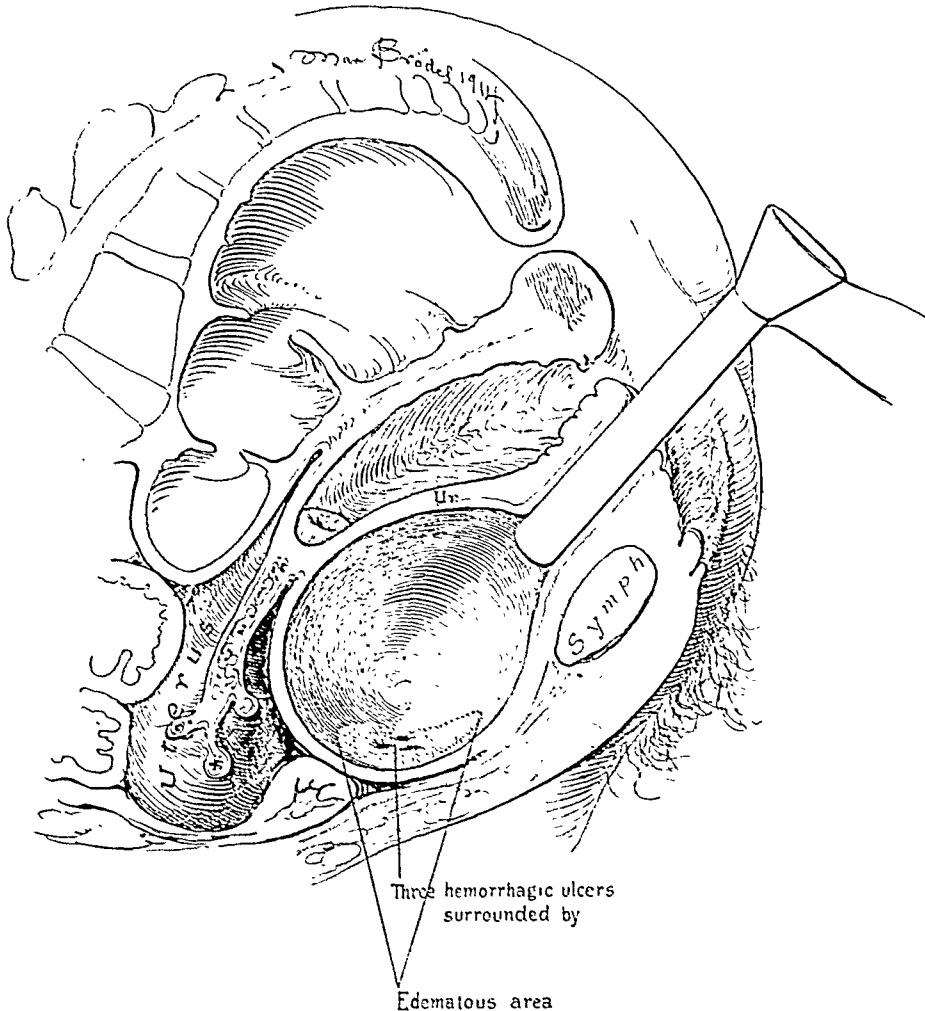
FIG. 35. Location of multiple minute ulcers (Hunner) on the right vertex, and the surrounding edema area found at operation. (From Hunner, Guy L. J. A. M. A., 70: 203, 1918.)

rid the meatus and lower urethra completely of all bacteria. On the other hand, when catheterization has to be repeated in the presence of residual urine or a recently traumatized bladder, as in patients with postoperative retention, the most rigid prophylactic measures often fail to prevent the development of cystitis. Such considerations as this have led most urologists to believe that cystitis as a primary entity occurs but rarely, and that the term should be condemned as a diagnosis and used only to designate a symptom complex consisting of painful and frequent urination associated with pus in the

urine. This symptom complex of course does indicate an inflamma-
tion of the bladder, but in most instances careful examination of the
patient will reveal that this inflammation is secondary to some
more serious though less overtly symptomatic lesion. The all too
common practice among practitioners and internists of hastily diag-
nosing cystitis on the basis of the above symptoms, and directing
treatment toward relieving the bladder condition alone, is not only
usually attended by failure in its purpose, but subjects the patients
to the dangers of delay in the diagnosing and treating of more
serious lesions. In a group of eighty-seven female patients with
cystitis at the Massachusetts General Hospital carefully analyzed
by G. G. Smith,[186] 61 per cent showed pyelonephritis, 19 per cent
renal tuberculosis, and 20 per cent either a local obstruction or a
pelvic or systemic infection, so that in not a single case could the
cystitis be considered as primary.

In spite of such considerations, however, most of us who have
dealt with urologic conditions in the female, have encountered a not
inconsiderable number of patients suffering from so-called simple
acute cystitis, in whom no associated lesions of any moment or
consequence could be demonstrated by the most careful methods
of examination. Such attacks may occur in association with pelvic
congestion incidental to a menstrual period, or following abnormally
violent or frequent coitus (so-called honeymoon cystitis) or as a
sequelum of the mildest types of respiratory infection. The gen-
erally recognized fact, that such a condition of apparently primary
simple cystitis is encountered almost exclusively in females, would
suggest that these attacks result from ascending urethral infection,
by the mechanism described above. Attacks of cystitis of this type
are usually of short duration and tend to yield readily and quickly
to simple forms of therapy. The failure so to respond to therapy
should tend to remove a case from this category, and lead to further
search, both in general examination and more especially in local
examination of the pelvis and urinary tract, for the primary cause
of the infection. The presence of conditions of the genital organs
such as prolapse and cystocele, large pelvic tumors, and pelvic
inflammations render a patient more susceptible to such attacks of
cystitis, and recurrences will tend to follow in more or less rapid
succession, despite successful treatment of the individual attacks,
until such pelvic conditions are corrected. As stated previously,
however, if the correction of the pelvic lesion involves operative

procedures, it is highly important, if possible that the urine be rendered sterile before operation in order to forestall more serious urinary tract infections during the postoperative convalescence.
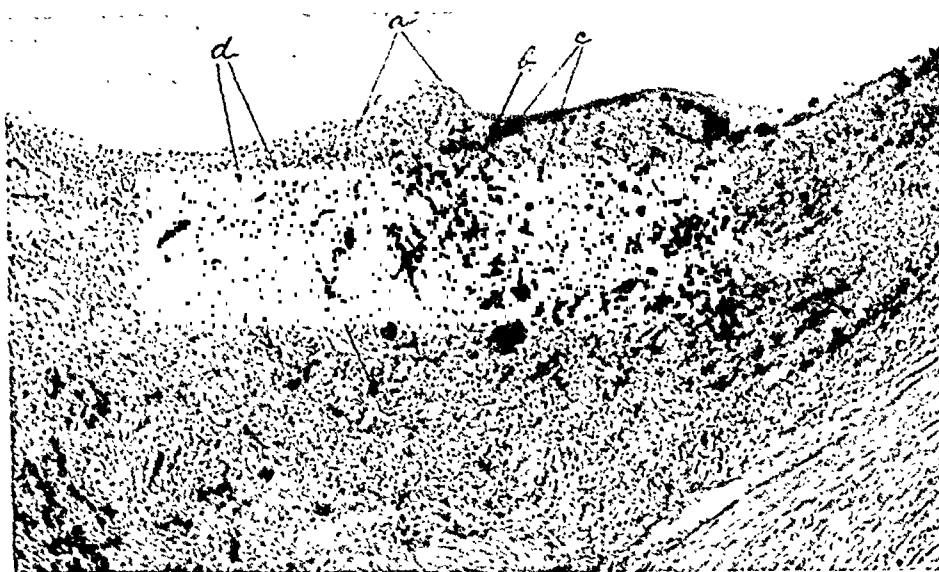
Fig. 36. Low power photomicrograph through an area of interstitial cystitis (Hunner Ulcer): a, gradual fading of the transitional epithelium; b, ulcer area made up largely of blood vessels; c, muscles in mucosa layer; d, blood vessels packed with leucocytes even in the deeper layer of mucosa. (From Hunner, Guy L. *J. A. M. A.*, 70: 203, 1918.)

The onset of such an attack is usually sudden. The symptoms are marked frequency and urgency and painful urination. The urine contains much pus and in the earlier stages usually some red blood cells also can be found. Occasionally the haematuria is sufficient to be observed grossly. Fever is usually absent if the bladder alone is involved.

Before treatment is instituted a careful history should be obtained and a careful physical examination including vaginal and rectal examinations should be performed in an attempt to discover any contributory etiologic factors. If such factors are discovered, they should be treated by appropriate measures if possible along with the treatment of cystitis. Cystoscopic examination during the acute stages is unnecessarily painful, and therefore apt to be unsatisfactory. It should be deferred until the acute symptoms have subsided, or until their failure to subside under appropriate treatment seems to indicate that the primary source of the trouble has not been discovered, and therefore must be sought more carefully by complete examination of the urinary tract. Until very recently

the unsatisfactory status of chemotherapy made it necessary to treat such conditions with irrigations and instillations of the bladder with mild antiseptic solutions. In the past few years the discovery of the usefulness of the salts of mandelic acid and sulfanilamide and its related compounds as urinary antiseptics, has greatly reduced the necessity of such local treatments. When treated by these older methods complete cure of even the mildest of such cases frequently could not be achieved in less than a month. If chemotherapy is effective at all, its purpose will usually be accomplished in a week or less. For the severer types of urinary tract infections, particularly if the upper tracts are involved the sulfa-drugs have been found to be more efficient than mandelic acid, so that recently there has been some tendency to discard the latter altogether. In the type of case under discussion, however, the author has found it most useful. The offending organism in these cases of simple acute cystitis is usually either the colon bacillus or staphylococcus, both of which are susceptible to this form of therapy. While the drug is unpleasant to take and usually produces mild disagreeable symptoms such as headache, dizziness and occasionally nausea and vomiting, it never produces severe toxic reactions such as sometimes result from the administration of sulfanilamide. Twelve Grams of either the ammonium or calcium salt should be given daily, the fluid intake should be reduced so that no more than a liter of urine will be excreted daily, and the common alkaline ash producing foods should be eliminated from the diet during the period of medication. In order that the drug may be effective the pH of the urine must be reduced to 5.5 or lower. This usually is accomplished by the third day without other medication, but failing in this ammonium chloride should be given in addition. The medication should be continued for a week, when, if the condition is really one of simple acute cystitis due either to colon bacilli or staphylococci, all symptoms will have subsided and the urine will be clear microscopically and sterile. If symptoms and pyuria should persist for more than three to four weeks in spite of adequate treatment, complete urologic study of the urinary tract should be made.

Chronic cystitis is characterized by the persistence over a longer period of time of symptoms similar to but usually less severe than those encountered in the acute condition. Such chronic inflammations of the bladder are rarely if ever primary, and their satisfactory treatment, therefore, usually entails the search for, location of, and

final elimination of the primary contributing cause. As the procedures necessary to accomplish this purpose may sometimes require considerable time, some symptomatic relief may often be given the
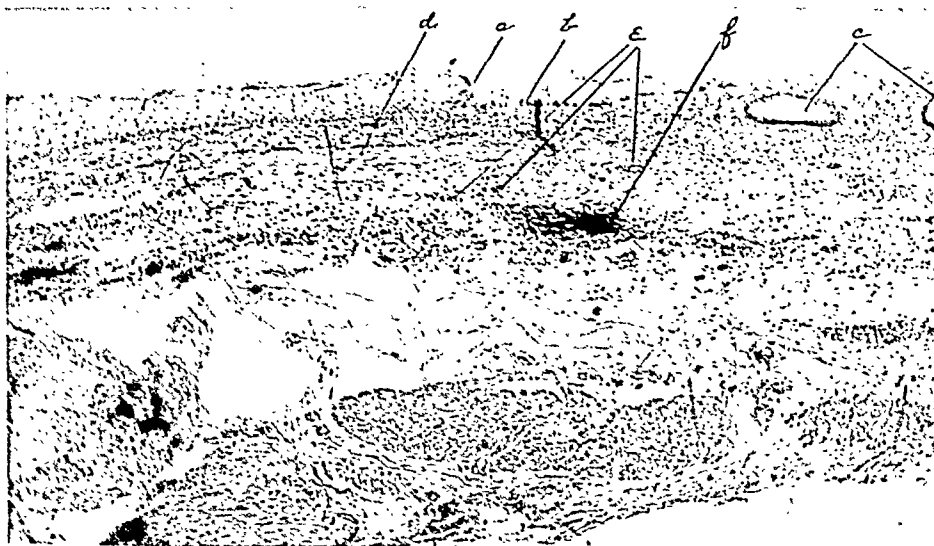
FIG. 37. Low power photomicrograph through an area of interstitial cystitis (Hunner Ulcer): a, abrupt ending of stratified epithelium at edge of healing ulcer; b, single layer of cuboidal cells; attempt at repair over the healing area; c, so-called cysts or glands, with mucous or goblet cell lining; d, smooth muscle in mucosa layer; e, blood vessels filled with leucocytes; f, collection of small round cells and leucocytes. General rarefaction due to edema. (From Hunner, Guy L. J. A. M. A., 70: 203, 1918.)

patient in the meantime by local treatment of the bladder. Such treatment usually should consist of irrigations of some mildly antiseptic and soothing solution such as 2 per cent boric acid, each of which should be followed by an instillation of 30 cc. of some more potent antiseptic. For the latter purpose various drugs such as mercurochrome 0.5 to 1 per cent solution, organic silver compounds, merthiolate 1–2000, and silver nitrate 1–1000 or 1–500 may be used. The irrigations and instillations may be given daily, but three times a week is usually sufficient in the chronic cases. Before the advent of the more effective chemotherapeutic agents now available, such measures also constituted the chief means of treating acute cystitis. In the chronic cases the relief given by such treatment will almost certainly be temporary and of brief duration unless the primary cause is located and eliminated.

If the contributing cause should prove to be a lesion of the genital organs, such as cystocele, uterine prolapse, or pelvic inflammatory disease, it will usually be discovered quickly; and when the cystitis is

dependent solely on such conditions, chemotherapy is apt to be effective, provided the pelvic lesions are treated appropriately at the same time. Where such factors as foreign body or tumor in the bladder exist, they are apt to be discovered early because the persistence of severe symptoms and particularly hematuria, in spite of ordinarily adequate conservative treatment, leads one soon to suspect that something more serious than a simple cystitis exists, and cystoscopic examination of the bladder alone reveals the obvious complicating lesion. Such cases are of relatively rare incidence, however, as compared with the great group of chronic urinary tract infections where the chronic cystitis is secondary to infection in the upper tracts. It is these cases that are most apt to be wrongly diagnosed by internists and practitioners, because of the fact that in many instances the symptomatology seems entirely limited to the bladder.

In examining a case of chronic cystitis associated with chronic upper tract infection, we usually find that the urethra is somewhat infiltrated and will accommodate easily only a No. 7 or 8 Hegar dilator as compared with the No. 10 which can be easily passed into the normal urethra. In most cases the mucous membrane of the bladder appears for the most part very nearly normal, except for some dilatation of the submucosal vessels. In the more intense cases, however, there may be diffuse reddening of the whole mucous membrane which in places may be ulcerated and covered with fibrin. In such intense cases the bladder usually requires some palliative treatment with irrigations and instillations before the ureters can be catheterized. More frequently, however, such an intense cystitis is not found, but rather what in a reality is a chronic trigonitis, in which the mucosa of the trigone appears thickened and opaque and often shows minute elevations giving it a rough granular appearance. If the upper tract infection is unilateral, this trigonitis is apt to be more marked on the side of the offending kidney, and a zone of few millimeters wide around the ureteral orifice may appear brilliantly red. Having made these observations in the bladder the ureters should be catheterized and microscopic and bacteriologic studies made of the individual kidney urines. The individual function of the two kidneys should then be determined, and finally plain x-rays, pyelograms, and pyeloureterograms should be made. These studies should result in an accurate diagnosis of the condition of the upper tract and upon this basis rational treatment can be instituted. If

renal stones, functionless pyonephrosis or renal tuberculosis are found to exist, the appropriate surgical measures should be instituted for the elimination of these lesions, and this having been accom-
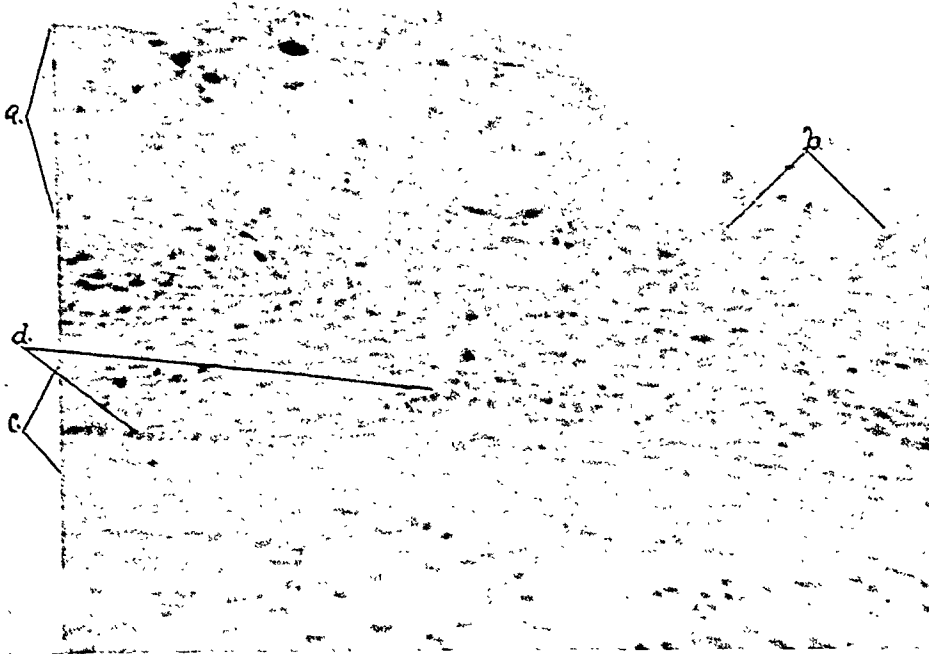
Fig. 38. High power (Zeiss D. D. 4.3 mm., reduced about one-half) photomicrograph of Hunner Ulcer: *a*, the horizontal arrangement and "hornified" appearance of the epithelial cells; *b*, single cuboidal layer over healing area; *c*, muscle cells of the mucosa layer; *d*, capillaries filled with leucocytes. (From Hunner, Guy L. *J. A. M. A.*, 70: 203, 1918.)

plished, the bladder inflammation will tend to subside spontaneously. Far more frequently, however, a low-grade chronic pyelitis or pyelonephritis will be found, probably originally caused and subsequently maintained by interference with adequate drainage. The causes of such interference with drainage may be found outside of or within the urinary tract. Among the former may be mentioned pressure upon the ureter from a pregnant uterus or tumors of the pelvic or other abdominal viscera, or an aberrant artery to the lower pole of the kidney, and dense scarring in the broad ligament regions as a result of pelvic inflammatory disease or irradiation of the pelvic viscera. Within the urinary tract we find such lesions as congenital or acquired intrinsic stricture of the ureter, abnormal angles at the pelvi-ureteral junction, and kinking of the ureter due to ptosis of the kidney. Of all the causes of such inadequate renal drainage, in our experience by far the most common is acquired intrinsic stricture of

the ureter, and the most satisfactory method of treating this lesion is by dilating the ureter through a Kelly cystoscope with wax bulbs molded upon ureteral catheters, or in cases with extremely dense strictures, with graduated bougies. The elimination of most of the other causes mentioned requires some appropriate surgical procedure.

In our experience with mandellic acid and sulfanilamide, we have found that while these drugs in proper doses will decrease the intensity of the infection and in some cases even procure sterile urine, the infection will quickly recur and return to its former intensity unless the cause of inadequate drainage has first been eliminated. On the other hand we have found that infection will often completely disappear without the aid of chemotherapy when adequate drainage has been satisfactorily established. Probably the most satisfactory procedure for the treatment of this group consists of first establishing adequate drainage by means of ureteral dilatations or appropriate surgery; and if after this infection still persists, a course of the proper chemotherapeutic agent.

2. *Interstitial Cystitis (Elusive Ulcer; Hunner Ulcer)*.   This condition was probably first described as "interstitial cystitis" by Skene, and in 1907 Nitze[163] (Lehrbuch der Kystoscopie) used the term "parenchymatous cystitis." These earlier works, however, dealt little with pathology and offered no solution to the problem of relieving the distressing symptoms. To Hunner, a gynecologist, is due all credit for the first systematic description of the condition and for suggesting effective methods of treatment. Hunner's[69] first publication (1914) was entitled "A Rare Type of Bladder Ulcer in Women with a Report of Eight Cases." He predicted, however, that with careful search the condition would be found also in men, and this proved to be the case as later reported by Kretschner,[127,128,130] Geraghty,[52] Bumpus,[10] Frontz,[48] and others. According to Ormond,[166] however, it occurs three to four times as frequently in women as in men. For this reason and because of the important contributions that gynecologists, particularly Hunner,[69,70,72,73,91] and Keene[109,110] have made to the subject it is one of particular interest to the specialist in female urology. It has been described under various names. In addition to those already cited may be mentioned "paracystitis" (Geraghty), "Submucous ulcer" (Bumpus), and "panmural ulcerative cystitis" (Keene). It was in 1918 at the suggestion of Cullen that Hunner[73] first used the term "elusive ulcer" as suggestive of the difficulties sometimes encountered in seeing the lesion

cystoscopically, the fact that the lesion is often missed, and the fact that the lesion visible by cystoscopic examination is usually quite misleading as to the extent of the whole disease process. John G.
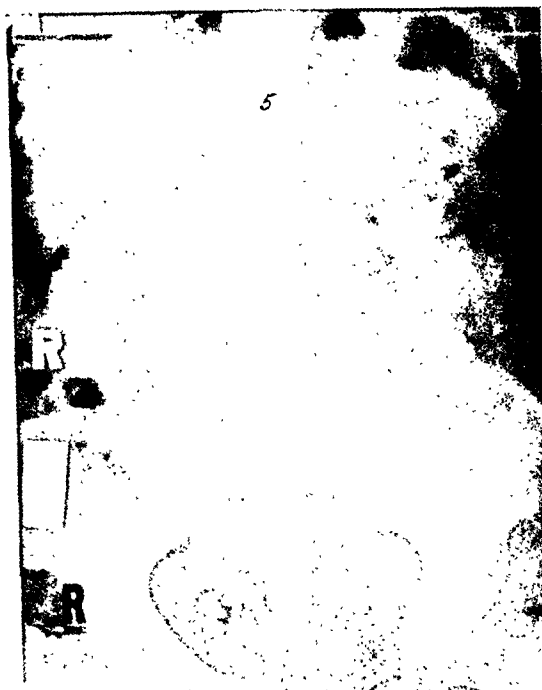
Fig. 39. Thirty-three minute intravenous pyelograms made three years after treatment with 2600 mc. hr. of radium emanations for stage III carcinoma of the uterine cervix. At the time of this examination the patient had been suffering for more than a year from an intense ulcerative cystitis with encrustations, which prevented location and catheterization of the ureteral orifices. Note the marked bilateral hydronephrosis. Plates taken earlier than thirty-three minutes following injection of diodrast showed very poor visualization. The patient developed a vesicovaginal fistula four years and seven months after irradiation and died of uremia one month later. Complete autopsy failed to reveal any remaining carcinoma. (From Everett, H. S. Am. J. Obst. & Gynec., 38: 889, 1939.)

Clark[17] objected to this term and suggested that "Hunner ulcer" be substituted. These two and "interstitial cystitis" are the terms most frequently used today.

The etiology of the condition is still not entirely settled. Hunner has believed since his second contribution that distant foci of infec-

tion in tonsils, paranasal sinuses or at the roots of teeth are probably
the most important factors, and in an analysis of 127 cases he found
sixty with associated ureteral strictures which he believes also usually
result from focal infection. Meisser and Bumpus[152] enthusiastically
championed this theory and were able to demonstrate a selective
affinity for the urinary tract in animals on the part of streptococci
isolated from foci of infection in patients suffering from such lesions.
Keene[110] could find no demonstrable focal infections in some of his
patients and could see no benefit from their elimination when found,
but from the pathologic character of the lesion he believed that it
was of hematogenous origin either embolic or toxic. The possibility
of tuberculosis as a factor was carefully considered by Hunner,
Keene, and others and eliminated on both bacteriologic and his-
tologic grounds. Any association between parity or conditions of the
pelvic organs has also been excluded. Keene was of the opinion that a
latent or recurrent renal infection might be the etiologic basis, but
admitted that in the majority of instances the demonstration of such
lesions was lacking. The condition has been described as beginning at
almost all ages from early youth on, and in Hunner's first twenty-five
cases the average age at onset of symptoms was twenty-five years.

Pathology. Careful descriptions of the lesions have been made by
most of those who have contributed to the subject, but Hunner's
original description has hardly been improved upon and may be
quoted in full:

"The histologic study of specimens removed at operation shows a fairly
uniform picture in all cases. It is a picture of chronic inflammation involving
all coats of the bladder and extending over the wide area which at operation
shows oedematous thickening. At the site of the minute ulcer there is loss
of the epithelial coat and the underlying mucosa shows the granulation
tissue characteristic of active ulcer. Other sections taken from what
appears to be an ulcer in the gross specimen show an abrupt ending of the
epithelial layer at the edge of an area that is evidently undergoing healing,
and here the mucosa layer is less richly supplied with capillaries, and is
much like the mucosa beneath the epithelial covering, showing a preponder-
ance of connective tissue and infiltration of round cells and leucocytes.
Such a healing area may be covered by a single layer of cuboidal cells.

"The mucosa layer in the neighborhood of the ulcer shows an increase
in the number and size of the capillaries, varying in different specimens.
The capillaries are often stuffed with leucocytes as are many of the lymph
spaces. There is an appearance of hyaline degeneration in some areas, and
in some of the sections the oedema causes rarefication.

[87]

"The muscularis mucosae seems to be hypertrophied in most of the specimens. The muscle coat shows enlarged lymph spaces filled with small round cells; these spaces as well as some of the blood vessels of the muscle
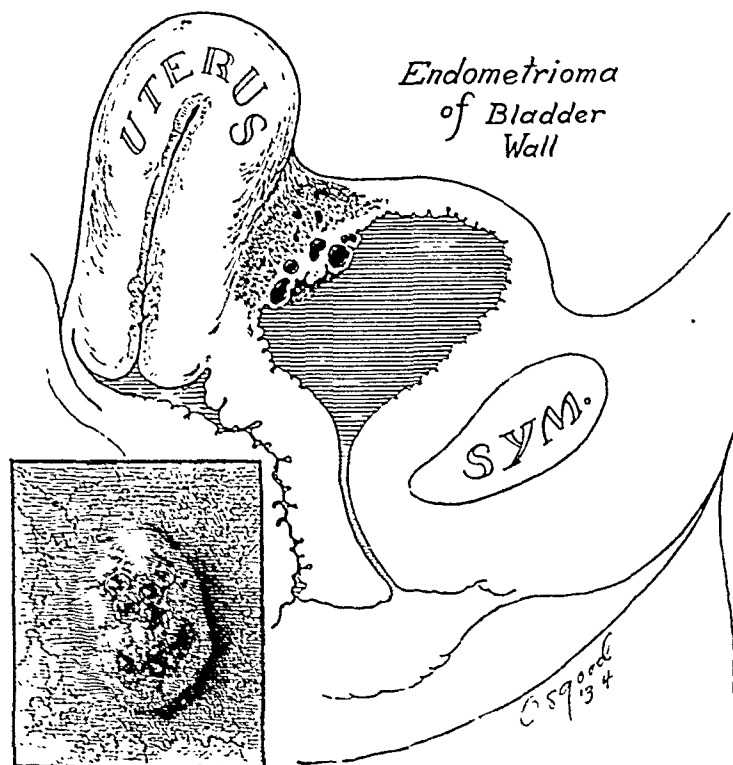
FIG. 40. Endometriosis of bladder. Diagrammatic sketch of bladder tumor in relation to the uterus. Inset: Gross appearance of tumor with the characteristic bluish cysts on the surface. The bladder mucosa about the tumor is injected and thickened. (From Henriksen, E. J. A. M. A., 104: 1401, 1935.)

coat, contain many leucocytes. Immediately beneath the ulcer, the muscle in places shows invasion and breaking up by the inflammatory process. The peritoneum, subtending a diseased area shows decided thickening."

Symptoms. The disease is characterized by its chronicity and by the extreme severity of symptoms referred to the bladder with relatively little to be found on examination of the urine. Hunner states that the chief symptom is pain associated with which other symptoms of cystitis occur in varying degree, namely, frequently day and night, strangury, burning and smarting. "The pain is often of the most extreme grade, the patient complaining of a jabbing or stabbing knifelike pain, or of a sensation of a jagged, sharp stick in the bladder." The pain may be referred to the perineum, vulva, suprapubic regions, along the course of the ureters, to the rectum, or down the

thighs. It is aggravated by walking, coitus or intestinal peristalsis. The severity of the pain with the loss of sleep resulting from the marked frequency often leads to complete nervous exhaustion. In Hunner's first twenty-five patients an average of ten years had elapsed since the onset of symptoms before the correct diagnosis was made, and many of them had been subjected to multiple surgical procedures without relief.

Diagnosis. With a history of symptoms such as have just been outlined, if the urine is grossly clear and shows only an occasional leucocyte and erythrocyte microscopically in the centrifugalized specimen, and is sterile on culture the condition should be suspected at once. If, as stated by Hunner, Geraghty and Ormond, slight distention of the bladder causes severe pain, and the slight distention is followed by terminal hematuria the diagnosis is almost certain. As with the urine examination, cystoscopy reveals remarkably little in view of the severity of the symptoms. The bladder, as a rule, is markedly contracted due to spasm and either a general anesthetic or prolonged local anesthesia from an instillation of 15 to 30 cc. of nypercaine (Ciba) 1–500 solution is usually necessary for a satisfactory examination. Hunner's description of the lesion as seen through the cystoscope is quoted:

"The cystoscopic picture is remarkable because of its almost negative character in most instances. Unless one is awake to the possibility of this lesion and goes over every portion of the bladder mucosa the conclusion is easily reached that the bladder examination is negative. There may be no portion of the mucosa that can be described as an actual ulcer area. One's attention may first be arrested by the unusually white appearance of most of the mucosa, or one may first discover a scar area entirely devoid of macroscopic vessels. Such a scar area will usually present one or more slightly congested area in the immediate neighborhood, and if these are touched with an instrument or with a dry cotton pledget in the alligator forceps there will be a slight oozing of blood. In the glazed dead-white portions of the mucosa the vessels are likely to present a broken or 'choppy' appearance, only short segments of vessels appearing on the extra pale surface. There may be small or speckled areas resembling the minute plaque-like red areas seen on the vaginal portion of an eroded cervix. At times the granular points are arranged in a circle which on the dead-white background resembles the lesion of a ringworm.

"As a rule, careful examination will discover one or more actual ulcerations. These may be situated anywhere in the vertex or free portion of the bladder, but they are most frequently found high in the vertex, and on

either side near the junction of the vertex, lateral, and anterior walls. This position just back of the symphysis is the most difficult portion of the bladder wall to examine with either the Nitze or Kelly method of cystoscopy.

a   b

FIG. 41. a and b, right and left pyeloureterograms of a white woman, aged sixty-four years, who had suffered from descensus of the uterus for eight years and complete procidentia for two years. She complained of no urinary symptoms. The prolapse was corrected surgically by Richardson's composite operation. Three months after operation pyelographic studies were repeated but showed no change from those shown here.

"These ulcer areas are always small, usually measuring not more than 5 mm. in diameter. They may be linear and measure from 0.5 to 2 cm. in length and from 1 to 2 mm. in width, and may thus resemble the mouse-eaten linear ulcer not infrequently found in a tuberculous bladder. Two or three minute ulcers may be found in a group, and they may be surrounded by a small red area of edema. The ulcers always appear to be superficial, and I have never seen them covered with necrotic membrane or urinary salts nor have I ever seen them present a picture suggesting malignancy. The bimanual palpation before cystoscopy may cause the ulcer to bleed, as may the splitting of the surface when the air distends the bladder if the patient is examined in the knee chest posture. Hence one may catheterize macroscopically clear urine at the beginning of the examination and be surprised to find bloody urine in the bladder immediately afterward on doing cystoscopy.

"The ulcer area may or may not be surrounded by a zone of radially converging vessels. One may find a minute ulcer, with or without edema,

around it and in another portion of the mucosa an edema area without an appreciable ulcer. These edema areas are generally seen immediately after the patient has been having an unusually bad period of bladder symptoms with much strangury.
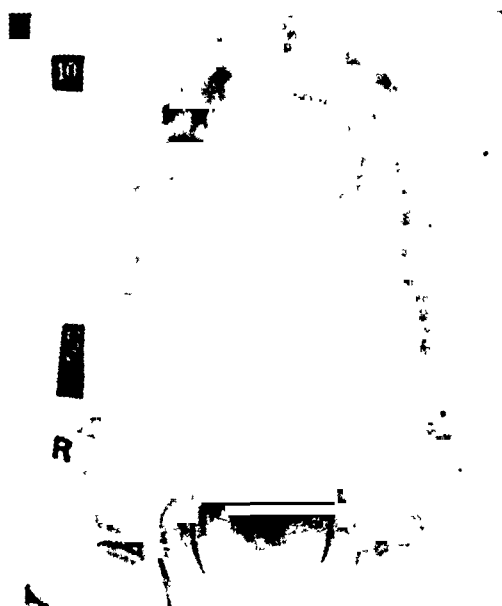
Fig. 42. Bilateral pyeloureterograms of a patient with a large pseudomucinous cystadenoma of the left ovary. Note moderate dilatation of pelves, calyces and ureters above the pelvic brim. Intravenous pyelograms sixteen days following surgical removal of the tumor showed that the urinary tracts had returned to normal size.

"The full extent of the infiltrated area is rarely discovered by cystoscopy, and at operation it is outlined by the redness and edema which arise during the preliminary freeing of the bladder from its surrounding tissues."

Ormond[166] states that the condition must be differentiated from tuberculosis and from granular urethritis which usually accompanies it. Hunner[72] who also found a chronic inflammatory reaction in the urethra felt that it was probably secondary to the severe strangury as it always disappeared following operative removal of the diseased area in the bladder.

Treatment. Ormond[166] in a recent article stated that treatment should consist of local treatment of the bladder lesion, general treatment such as rest, elimination of foci of infection, and correction of

anemia, and treatment of concomitant granular urethritis by urethral dilations. He listed eight types of treatment that have been used for the local lesions as follows: (1) Distention of the bladder either rapid under anesthesia or gradual without anesthesia. The pain is usually relieved but frequency persists and the pain recurs in three to four months. (2) Irrigations and topical applications with corrosive substances such as silver nitrate and pure phenol; (3) intravenous mercurochrome; (4) ureteral dilatations; (5) fulguration; (6) excision; (7) transplantation of ureters in extensive intractable cases; and (8) Resection of presacral nerves. Little or no success had resulted from measures 3 and 8.

In the earlier reports on the subject excision was considered the treatment of choice by Hunner and most others. The pain was completely relieved, and except for moderate frequency in some cases from a reduction in the size of the bladder due to the necessity of excising a large area, the patients seemed cured. Later, however, in reviewing 127 cases, forty-eight of which had been treated by excision, Hunner[91] found recurrence in 42 per cent. Such findings as this on the part of most of those interested in the subject have greatly diminished the earlier enthusiasm for excision.

The treatment which seems to have proved most satisfactory with the test of time is first, thorough attention to the general health of the patient with elimination of all possible foci of infection; second, complete examination of the entire urinary tract with treatment of any concomitant lesions there. Hunner[91] found ureteral stricture in sixty of 127 patients and noted marked symptomatic improvement following ureteral dilatations alone; third, treatment of the diseased area in the bladder, either by fulguration or the application of such caustics as pure silver nitrate or pure carbolic acid (Sears[180]). These measures are not curative except in an occasional patient who after repeated treatment seems to obtain permanent relief. They do, however, give satisfactory relief for a time which varies from a few months to about a year after which the treatment must be repeated. The relief as a rule persists longer following fulguration than after chemical application.

3. *Neoplasms.* Primary neoplasms of the bladder occur considerably more frequently in men than in women and therefore will not be considered here. Neoplastic disease of the female genital organs, however, frequently exert a profound influence upon the bladder as well as other part of the urinary tract. In the case of

benign tumors the effect exerted upon the bladder is usually that of distortion from external pressure. In a recent study by Everett and Sturgis[43] of the effect upon the urinary tract of a variety of gyne-
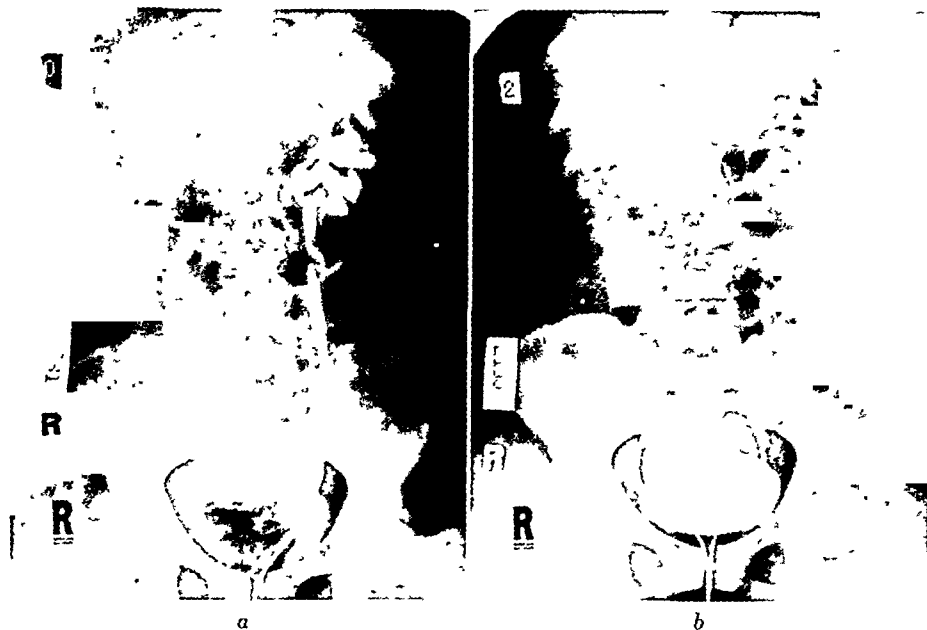
FIG. 43. a, dilated ureter, pelvis and calyces on the left side in a patient with a large uterine fibroid. Intravenous pyelograms had shown a normal right tract, but poor visualization of the left tract. b, bilateral pyelograms two months after removal of the tumor show that the left tract has reverted to almost normal proportions.

cologic conditions there were forty-seven patients with uterine myomas in 21.3 per cent of whom such distortion of the bladder was found, and in the thirty patients in whom the myomas were sufficiently large to extend above the pelvic brim, the percentage of bladder distortion was 26.6 per cent. Moreover eighteen or 38.3 per cent of these forty-seven women complained of bladder symptoms such as frequency, nocturia and dysuria, but the urine was infected in only ten or 21.3 per cent, so that the bladder discomfort must have been due to some other cause than infection. The most probable cause in this particular group would seem to have been the distortion from external pressure of the tumors, as in most of them, even those in whom the urine cultures were positive, the symptoms were relieved following removal of the fibroids. Similar findings were encountered in a smaller group of ten patients with ovarian tumors, 20 per cent of whom showed distortion of the bladder, and 30 per cent

of whom complained of bladder symptoms, although the urine was infected in only one.

Malignant tumors arising in the genitalia may also produce distortion of the bladder by external pressure or fixation, but more important still they may extend to and directly involve the bladder wall in the malignant process. Such effects may be exerted by any type of malignant pelvic tumor, but as carcinoma of the uterine cervix occurs far more frequently than all other types of genital malignancy combined, it has been subjected to more intensive study in regard to its effects upon the urinary tract than have other types of malignant neoplasms. The behavior of this type of carcinoma toward the bladder will, therefore, be taken as an example of the possible effects which may be exerted by a variety of pelvic neoplasms and will be treated in some detail.

Excellent studies of this subject have been reported by Aman-Jean[2] in France, and by Graves, Kickham, and Nathanson[55] from the Pondville Hospital in Boston, and the interested reader may refer to their articles for details and complete bibliography. In both of these articles the importance of cystoscopic examination of the bladder before, during, and after treatment as an aid to the evaluation of prognosis, the progress of the disease, and the success or failure of treatment were stressed. The Boston group recorded cystoscopic studies on 105 patients, forty-three of whom were studied before the institution of therapy, and sixty-two during or after therapy. In only sixteen of these was no effect traceable to the carcinoma observed. In fifty-three cases there were effects which could not be ascribed definitely to invasion of the bladder by the carcinoma. These were described as distortion of the bladder from extravesical pressure, termed "bombement" by Marzetti[146] and Aman-Jean;[2] trigonal edema, and both distortion and trigonal edema. The first of these effects was observed in eighteen cases, the second in twelve, and the combination of the two in twenty-three.

The distortion from extravesical pressure consists usually of a uniform elevation of the proximal trigone and posterior wall, covered with normal mucosa and unaffected by distention. The interpretation of this finding should be made with caution, and guided by the findings on vaginal examination as it may be produced by the tumor, by the reaction following irradiation, by an inflammatory process in or around the uterus, or merely by an anterior lying fundus. The fact that Korkhov[125] found by cystoscopic inspection a
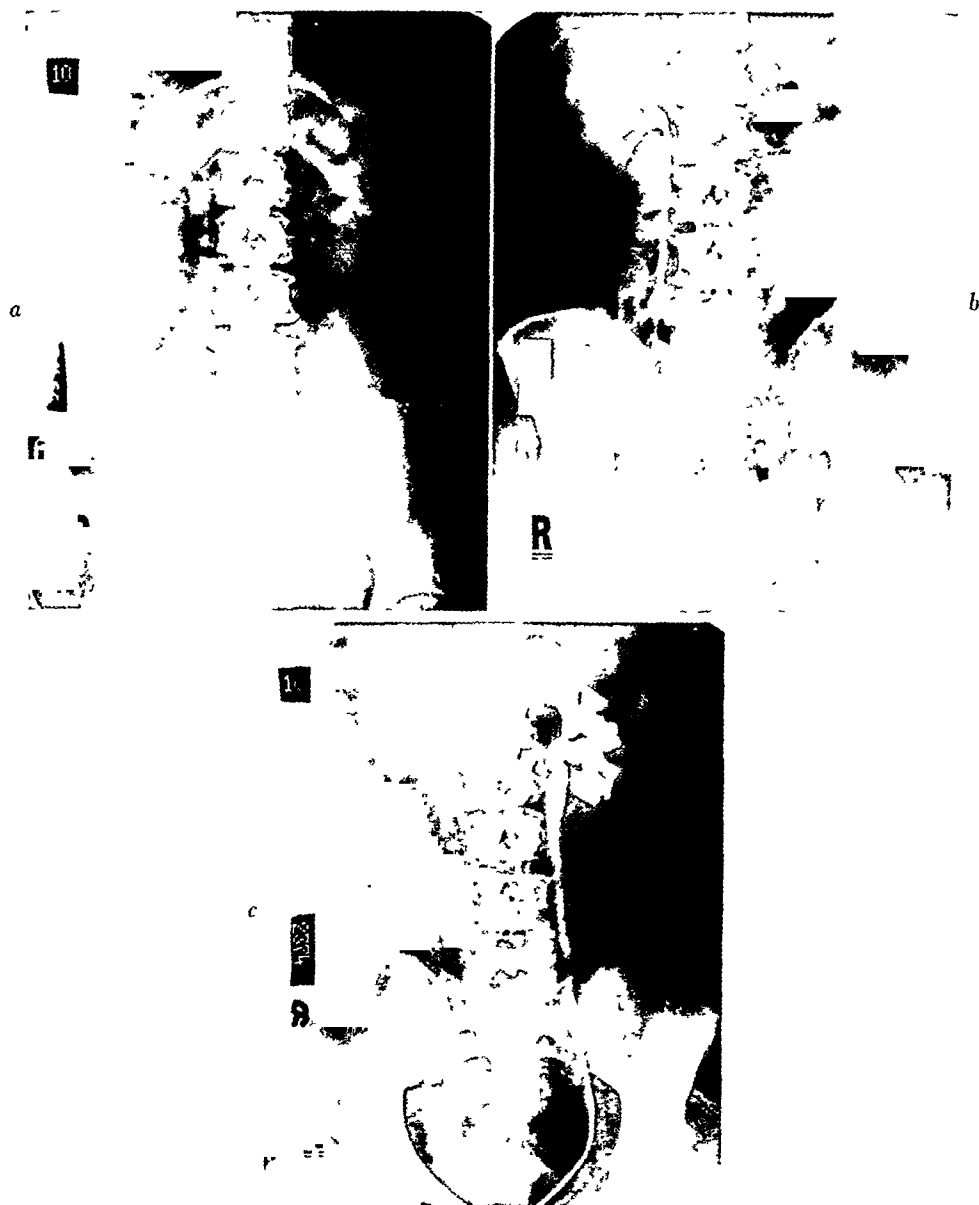
FIG. 44. *a*, one hour intravenous pyelograms before operation of a patient with a myomatous uterus extending to the costal margin, bilateral chronic salpingitis and abscess of the left ovary. Note the marked dilatation of ureters and renal pelves on both sides with poor visualization of the left tract. *b*, retrograde right pyeloureterogram two months after operation (hysterectomy and bilateral salpingo-oophorectomy) shows that the tract has returned to essentially normal proportions. *c*, retrograde left pyelogram nine months after operation shows persistent dilatation of the left tract. This was the side upon which there was an ovarian abscess which leads to speculation as to possible rôle of this more intense pelvic inflammation in producing the permanent dilatation of the urinary tract on this side.

definite improvement in the bladder outline following irradiation in fifty of one hundred cases, and that similar observations were made by Aman-Jean indicates, as stated by the latter author, that such observations may constitute a guide as to the efficacy of treatment.

Schmitz,[176] Vermooten,[210] and others believe that oedema of the bladder base probably in most instances signifies invasion of the bladder wall by carcinoma beneath the area of oedema, but Graves[55] and his associates are of the opinion that an inflammatory reaction around the tumor in a region adjacent to the bladder may also produce such a picture.

Invasion of the bladder wall by the tumor ultimately produces a submucous nodule or actual projection of the neoplasm into the bladder cavity with or without ulceration. Such was the case in twenty-three of the 105 cases studied cystoscopically by Graves and his associates. This finding definitely places a case in grade IV as regards extension, and as ten of the twenty-three patients mentioned above had been classed in grades II or III from the findings on vaginal examination, the value of cystoscopic study as an aid to classification and prognosis is readily seen.

The end stage of actual bladder involvement by cervical carcinoma is the formation of a vesicovaginal fistula, and Graves and his associates believe that most patients with actively progressive disease will eventually develop such fistulae unless death occurs sooner from hemorrhage, uremia or some other cause. They found fifty-five fistulae in 425 patients, or an incidence of 12.9 per cent and the average length of life after the appearance of the fistula was only five months. Autopsy studies by Behney,[6] Warren,[215] Williams,[220] and Faeber[44] showed incidences of vesicovaginal fistulae of 22.3 per cent, 35.3 per cent, 38 per cent, and 45.3 per cent, respectively.

Of more practical importance from the point of view of therapy than the actual invasion of the bladder by carcinoma, are those lesions which result from the treatment of carcinoma and other genital disorders by irradiation. These lesions frequently occur in patients in whom the carcinoma has been arrested or even cured, and have been described by Dean,[34,35] Newell and Crossen,[162] Smith,[187] Colby,[21] and Everett.[42] Dean who probably has given the clearest description of such conditions has mentioned three types of reaction to irradiation found in the bladder as follows:

"Primary erythema occurring within twenty-four hours after treatment and being merely a nonspecific reaction to local irritation.

"Secondary erythema appearing usually about twenty-eight days after treatment and being a specific reaction to irradiation, probably due to temporary vasodilatation.

<center>a   b</center>
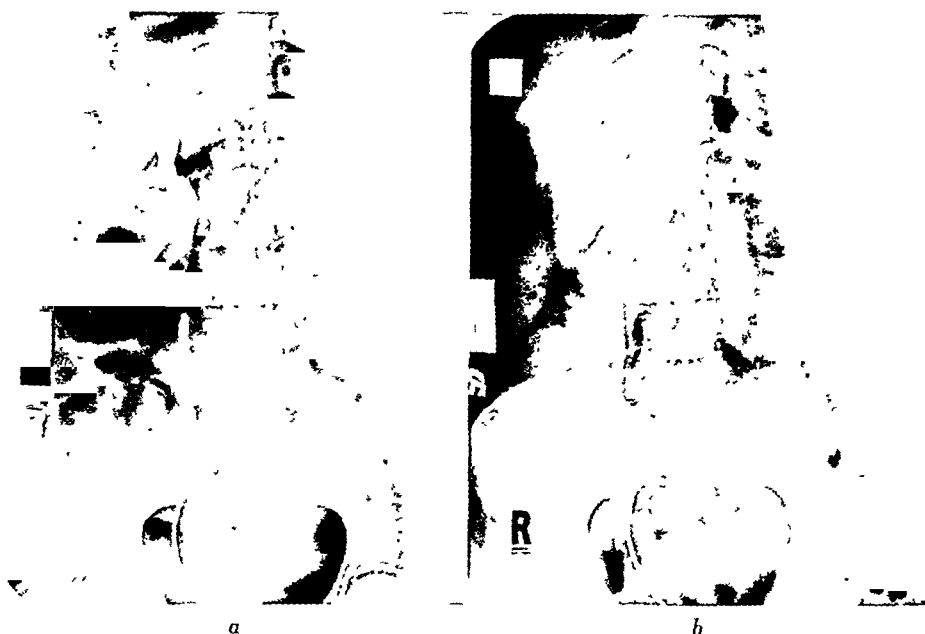
FIG. 45. Right pyeloureterogram of a patient with extensive pelvic cellulitis. The left side was similar to the right and there was colon bacillus infection and reduction of function on both sides. The patient was treated by transfusion, sulfanilamide and diathermy. There was marked symptomatic improvement, the urinary infection was eradicated and the function of the kidneys returned to normal. *b*, shows the change in the right urinary tract after six months. On the left side where there was some persistence of pelvic induration no such change occurred in the urinary tract.

"Tertiary reaction consisting of obliterative endarteritis with sloughing and ulceration of the tissues. These lesions are often covered with grayish slough or gritty deposits and can only be definitely distinguished from carcinomatous invasion by biopsy. They rarely appear earlier than a year and may appear as late as ten years after treatment with an average of two and one-half years."

Dean found an incidence of 2.5 per cent of such tertiary ulcerations in all patients treated and 7.3 per cent in those retreated, and Newell and Crossen found slightly more than 1 per cent. Everett,[42] in a study of only those patients in whom the carcinoma was apparently arrested or cured, found an incidence of 18 per cent, and Colby,[21] whose statistics were compiled in a similar manner reported an incidence of 34.3 per cent. The ulcerations went on to the forma-

<center>[97]</center>

tion of vesicovaginal fistula in two of Smith's seven cases, seven of Colby's twelve cases, and two of Everett's seven.

In one of Everett's patients who eventually developed a fistula the ulceration involved the whole of the base and trigone and was covered by a dirty membrane containing calcareous deposits. There was marked ureteral obstruction and the patient died of uremia five years after treatment of the carcinoma. Autopsy failed to reveal any evidence of remaining carcinoma.

In view of the relatively small dosage of irradiation that had been given some of these patients, Dean suggested the probability of individual susceptibility of the bladder tissues to such injury. Most of the authors are agreed that unless fistulae develop the ulcers eventually tend to heal, but that the healing process is a slow one. Various types of treatment have been suggested from simple irrigations to fulguration of the ulcer base, but all are agreed that a most important item is the avoidance of further irradiation, a procedure which may well be suggested and carried out unless the lesions are carefully differentiated by biopsy from carcinomatous invasion.

Everett found some type of bladder disturbance in approximately 55 per cent of his cases. Some showed the secondary reaction described by Dean but it usually occurred later than was observed by that author. Others showed areas in the base of the bladder in which the mucous membrane as a whole was abnormally pale but showed evidence of petechial submucosal hemorrhages. Since three patients presenting this picture later developed ulcerations, it was considered as possible evidence of an earlier phase of the ischemic process which eventually leads to ulceration.

4. *Endometriosis.* An exceedingly rare condition but one of exceptional interest to the gynecologic urologist is endometriosis of the bladder. The first case of this nature was reported in 1921 by Judd[106] and since that time perhaps forty others have been recorded. In Judd's case the condition was considered to be primary in the bladder, and Henriksen[59] in 1935 reported what he believed to be the twenty-first case belonging to this classification. Henriksen was of the opinion "that the term 'primary vesical endometriosis' should be limited to those cases in which no demonstrable contiguity with the uterus, fallopian tube or ovaries is present, and in which there has been no surgical trauma of the bladder wall or its peritoneal reflexion." In 1939, Reynolds[172] was able to collect thirty-four cases all primary. In view of the relative frequency of endometriosis involving

the genital organs and pelvic peritoneum it would seem logical to suppose that cases of bladder involvement secondary to the process in the adjacent pelvic viscera would occur more frequently. This,
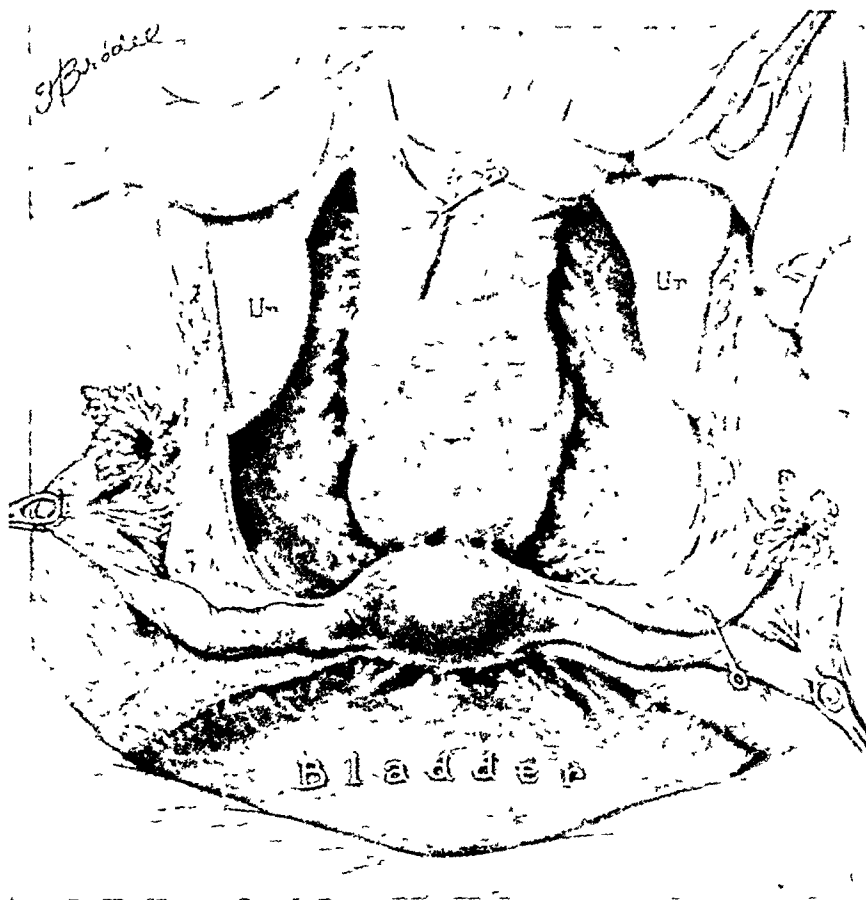
Fig. 46. Showing marked dilatation of the ureters above the pelvis and a uretero-peritoneal fistula at x on the left side. There was also a large vesicovaginal fistula. These developments followed eighteen months after irradiation therapy for carcinoma of the uterine cervix. Complete autopsy revealed that the carcinoma had been entirely eradicated. (From Hunner, G. L. and Everett, H. S. J. Urol., 28: 333, 1932.)

however, has not proved to be the case, at least in so far as can be found in a review of the reports to the present time. Keene[111] reported two such cases in 1925 and ten years later Henriksen was able to find reports of only nine similar ones.

Most of the reports have dealt extensively with the theories of the origin of endometriosis, particularly the primary vesical type. While

such discussions are of considerable interest to the gynecologic pathologist they are of little value to the practical urologist.

The condition consists of a tumefaction in the bladder wall situated slightly above the interureteric fold in the region of the uterine prominence. If the specimen is obtained for microscopic study, it will show endometrial type glands with or without stroma embedded in a fibromuscular matrix.

The symptoms are usually gradual in their onset and consist of bladder cramps, dysuria, frequency and terminal hematuria, present only, or certainly most marked in association with the menstrual periods. Most of the recorded cases have occurred in women between the ages of thirty-five and forty-five. On cystoscopic examination the tumor appears as a sharply defined area of congestion posterior to the interureteric fold which may involve one or both ureteral orifices. Through the mucosa bluish cysts may be seen, and if there is mucosal involvement bluish translucent grape-like projections may extend into the bladder cavity. If there is involvement of an ureteral orifice, in addition to the bladder symptoms there is apt to be renal pain on the affected side at the time of the menstrual periods. The urine is usually normal except for hematuria which occurs only during menstruation.

The treatment should be varied according to conditions found in the individual case. In the primary cases if the patient is young and desires children and there is no ureteral involvement, surgical excision of the tumor should be done. If the patient is near the menopause or if there is ureteral involvement, castration by irradiation is the treatment of choice. In the secondary cases surgical castration is preferable, in that it permits attention to other foci of endometriosis at the same time. Each of these forms of treatment usually has been successful in relieving the patients of all urinary symptoms.

5. *Stones and Foreign Bodies.* Vesical calculi occur extremely rarely in women as compared with men except as secondary deposits around foreign bodies. Among 1,007 cases cited by Sir Henry Thompson[203] only fourteen were adult females. Among Lower's[143] series of 157 cases only nine were in females. Since as has been mentioned bladder infections occur considerably more frequently in female than in male patients, this rarity of stones in the female must be due to the low incidence of small caliber obstructions of the urethra and vesical neck. On the other hand foreign bodies introduced into the bladder by patients themselves are found considerably more fre-

quently in women than in men. Such mishaps usually result from masturbation or attempted abortion and lists comprising a great variety of objects so introduced have been compiled. Commonly found in such lists are such objects as hairpins, lead pencils, knitting needles, small wooden sticks and so on. Furthermore such objects as bits of catheters or rubber tubing may occasionally break off and be left in the bladder, or the bladder wall may be penetrated by a suture during pelvic operations. Rare cases have been recorded in which material from a dermoid cyst or fetal bones from a neglected extra-uterine pregnancy have made their way into the bladder. Stones are apt to form from the deposition of urinary salts around any such foreign body left in the bladder, and the rapidity with which this may take place is often surprising. Beginning encrustation of such an object may often be observed within a very few days from its introduction.

The symptoms of foreign body in the bladder are usually those of a severe cystitis, namely, marked frequency, urgency, pain and strangury. Pus and blood in abundance are usually present in the urine. Intermittent retention of urine may occur from blockage of the vesical neck by the stone. If such symptoms have persisted for a con-siderable period before the patient seeks medical aid, the introduc-tion of a foreign body during masturbation or in attempted abortion should be suspected at once.

If the stone or foreign body is large it can be felt on vaginal examination, and often can be sounded with a glass or metal catheter. A roentgenogram of the bladder region and cystoscopic examination may be relied upon to make the diagnosis conclusive.

If the foreign body is small or elongated and of small caliber, it usually can be removed through a Kelly cystoscope with alligator forceps. Stones too large to be removed in this way may sometimes be crushed and the particles removed, or a stone only slightly larger than the lumen of the cystoscope may sometimes be grasped through the instrument and drawn out through the urethra simultaneously with removal of the cystoscope. If the stones are large and hard, or if they or portions of the foreign body around which they may have formed are embedded in the bladder wall, it is usually wiser to resort to cystotomy than to attempt removal through the urethra. In the adult parous female the simplest approach for cystotomy is through the vagina and this method usually can be used with entirely satis-factory result, unless some other lesion is suspected such as tumor or

diverticulum which requires thorough and complete exploration of the bladder. Under these circumstances suprapubic cystotomy will be found more satisfactory. With either approach if the associated cystitis is severe the bladder incision should be closed around a drainage tube and a catheter should be left in the urethra to permit thorough through-and-through irrigations.

VII. OBSTRUCTIVE LESIONS OF THE UPPER URINARY TRACTS

1. *Ureteral Obstructions Resulting from Gynecologic Lesions.* The urologic diseases of major importance which affect the kidneys are the same in both sexes, and since their surgical correction, when called for, entails the same technical principles and is fully treated in all standard works on urology, as well as in the general literature, further detailed treatment of these subjects would be superfluous. It is a well recognized fact, however, that certain diseases of the kidneys such as hydronephrosis, pyelitis, pyelonephritis, pyonephrosis, and calculi, in large measure result from some lesion producing an interference with the normal escape of urine from the renal pelves, or in other words to urinary stasis in the upper tracts. In the male the lesions responsible for such stasis are found most often at the vesical neck or in the urethra, and consist of such conditions as hypertrophy of the prostate, or small caliber stricture of the urethra. In the female, however, obstructive lesions below the bladder sufficient to produce urinary retention are extremely rare, and the etiologic basis for upper tract stasis is most frequently found in some condition which interferes with the normal conduction of urine by the ureters from the renal pelves to the bladder. In the paragraphs quoted in the introduction to this article from Kelly's[112] publication in 1888 upon palpation of the ureters, are mentioned such conditions as pressure from uterine and ovarian tumors and the gravid uterus, retroflexion and prolapse of the uterus, constriction from parametric scars, retroperitoneal sarcoma, and carcinoma of the uterus, as well as the dangers of ureteral injury during gynecologic operations for the correction of some of these and other gynecologic disorders.

Thus at this early date, before a cystoscope adequate to permit easy catheterization of the ureters and study of the upper urinary tracts had been invented, the master mind of Kelly pointed out the close relationship between gynecologic lesions and gynecologic surgery and many diseases of the upper urinary tracts. Since that time the subjects thus set forth briefly by Kelly have been elaborated

upon from time to time by many others. Concerning the effect upon the urinary tracts of some of these conditions, notably pregnancy and carcinoma of the uterine cervix, a very extensive literature has

FIG. 47. Autopsy specimen of the right kidney and upper ureter from the same case as Figure 46. The two kidneys were similar in appearance. (From Hunner, G. L. and Everett, H. S. *J. Urol.*, 28: 333, 1932.)

developed, while in regard to most of the others only an occasional article has appeared.

In 1923, Brettauer and Rubin[5] made a careful clinical study of the upper urinary tracts in eleven women, ten of whom were suffering

from prolapse of the uterus and cystocele, and one from cystocele without prolapse. In eight of the ten with prolapse and in the one without prolapse hydroureter and hydronephrosis were found. They
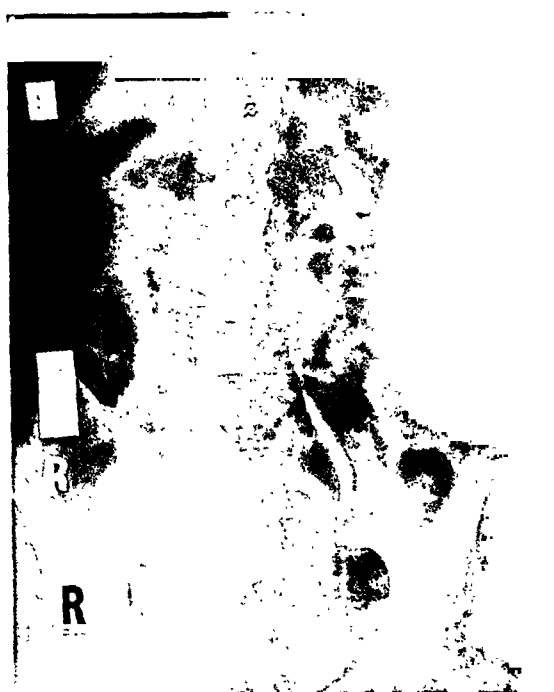
Fig. 48. Left pyeloureterogram made six months after 3,109 mc. hr. of radium emanations and 8,400 r of deep x-ray therapy for stage II cervical carcinoma complicated by a small uterine fibroid. Note moderate dilatation of the ureter and pelvis. Intravenous urograms taken before treatment showed normal tracts. (From Everett, H. S. Am. J. Obst. & Gynec., 38: 889, 1939.)

reviewed the work of previous authors namely Tandler and Halban,[58] Froriep, and Hirakawa, all of whom had reported similar findings from studies of autopsy material. These authors, however, had all concluded that the ureteral and pelvic dilatation had resulted from compression of the lower ends of the ureters at the point of their herniation through the hiatus genitalis, while Brettauer and Rubin believed, that in the cases of uterine prolapse at least, the dilatation was due to kinking and compression of the ureters by the drag of the prolapsed uterine arteries. Wallingford[211] in 1939 reported six cases with prolapse, all of whom showed upper tract dilatation, and one of whom died of uremia resulting from the severe damage to the kidneys. From a study of this material, he came to the same conclu-

sion as to the mechanism of stasis as did Brettauer and Rubin. Kretschmer and Kanter[131] found bilateral dilatation of the ureters and pelves in only one of four patients with prolapse, but the degree of the prolapse is not stated. Everett and Sturgis[43] found one case of bilateral and one of unilateral dilatation among four patients with complete prolapse, and three cases of bilateral and one of unilateral dilatation among ten patients with partial prolapse.

In a recent study of one hundred patients to determine the effect upon the urinary tract of a variety of gynecologic disorders Everett and Sturgis[43] found bilateral dilatation of the ureters and renal pelves in 31 per cent and unilateral dilatation in 19 per cent, or some demonstrable effect in 50 per cent of the total group. The proportion of dilatation found among the various groups of gynecologic disorders represented was as follows: Large myomas (above the pelvic brim), 66.6 per cent of thirty patients; small myomas, 29.4 per cent of seventeen patients; chronic salpingitis, 44.4 per cent of nine patients; subacute salpingitis with pelvic masses, 58.3 per cent of twelve patients; pelvic abscess, 57.2 per cent of seven patients; ovarian cyst, 40 per cent of five patients; ovarian carcinoma, 60 per cent of five patients; complete procidentia, 40 per cent of four patients; incomplete uterine prolapse with cystocele, 40 per cent of ten patients. Kretschmer and Kanter[131] in a similar study limited to uterine myomas and ovarian cysts except for four patients with uterine prolapse and one with pelvic abscess, found upper tract dilatation in 62.5 per cent of twenty-four patients with large myomas, 54.5 per cent of eleven patients with small myomas, and 81.9 per cent of eleven patients with ovarian cysts. There was a return to normal following appropriate surgical procedure in 72.5 per cent of the total group. As yet only twenty-five of the fifty patients showing upper tract dilatation in the group studied by Everett and Sturgis have been restudied since completion of their gynecologic treatment. Of these twenty-five, in fourteen, or 56 per cent, the urinary tracts have returned to normal, while in eleven, or 44 per cent, some degree of dilatation has persisted. This greater incidence of persistent dilatation than was found by Kretschmer and Kanter can probably be accounted for by the inclusion in the group of patients with pelvic inflammatory conditions, in whom the removal of the masses does not eliminate entirely the periureteral and ureteral scarring, which may have resulted from the presence of the inflammatory process in the neighboring pelvic structures.

In the group studied by Everett and Sturgis there were no symptoms elicited from any of the patients which could have been definitely attributed to the abnormalities found in the upper urinary tracts, although 46 per cent of them complained of some degree of bladder discomfort. In most instances, however, this was of the mildest type. The bladder urine was infected in 26 per cent, but only 7 per cent showed infection of the upper tracts, and there was evidence of diminution in renal function in only 10 per cent. The persistence of dilatation in 44 per cent of those restudied after the completion of satisfactory gynecologic treatment, is indicative of the possibility that more serious diseases of the kidneys may occur later as a result of the processes initiated by the original gynecologic condition, and therefore indicates that the possible effect on the urinary tract should be carefully considered in every patient suffering from a major gynecologic disorder. The absence of localizing symptoms referable to the kidneys or ureters in so large a group of patients showing hydronephrosis and hydroureter, further emphasizes a fact, often pointed out by urologists, of the frequent symptomatic silence of many serious lesions of the upper tracts. In 1937, in attempting to emphasize the importance of careful urologic study of the upper urinary tracts in patients presenting persistent or recurring symptoms of cystitis, or presenting obscure diagnostic problems, the author[39] under the title "Disproportion between Symptomatology and Pathology in Urinary Tract Disease," reported ten cases, selected from among many other similar ones of his experience, as furnishing most striking illustrations of this point. Among these ten cases were included three of renal calculi associated with chronic pyelitis or pyelonephritis, two of chronic pyelonephritis without calculi, one of uninfected functionless hydronephrosis, two of renal tuberculosis, and two of malignant renal tumor. In his untiring crusade to emphasize the frequent occurrence and importance of ureteral stricture, and the protean character of the symptomatology of this disease, Hunner has time and again called to the attention of the profession at large the importance when dealing with patients presenting obscure diagnostic problems, of remembering that they possess a urinary tract, and that adequate examination of this tract will often reveal the source of the trouble when all other measures have failed. In spite of the widespread recognition of these facts on the part of urologists, however, until quite recently their importance and truth have not seemed to arouse the interest of the

medical diagnosticians. Many patients, after complete studies
including roentgenograms, of most of the organic systems of the
body with negative results, were consigned to the scrap-heap of
functional neuroses without an examination of the urinary tract,
because in the absence of pathologic findings in the urine and of
symptoms pointing obviously to this system, the painful procedures
of ureteral catheterization and retrograde pyelography seemed
unwarranted to the physician in charge. The advent of intravenous
urography, as well as the recent case reports of hypertension arising
from unilateral renal disease, have done much to dispel this hesitancy
on the part of our medical brethren to request urologic consultation.

The eventual encroachment upon and occlusion of the ureters,
with resulting renal damage and death from uremia has long been
recognized as one of the most frequent modes of exodus from un-
treated or uncontrolled malignant disease of the genital organs, and
particularly of cervical carcinoma. Furthermore, so long as radical
operations remained the chief means of treating this condition, it was
also recognized that these operations more than any others entailed
the risk of ureteral injury. It was not until quite recently, however,
that there was any recognition of the fact that serious damage to the
urinary tract might result from irradiation therapy.

The slowness with which this fact became recognized was no
doubt due to the hesitancy that naturally exists, when signs of
ureteral obstruction occur in a patient known to have had carcinoma,
not to attribute the obstruction to persistence and spread of the
carcinoma. Indeed the burden of proof does rest upon one who would
claim otherwise. However, autopsy studies by Behney[6] and by
Morton[157] have revealed the tremendous destructive effect upon
normal tissues that may result from irradiation in some instances.
Such destructive effects upon the bladder are observed frequently,
and have been discussed in a previous section. In 1929, Hunner and
the author[98] reported the case of a patient in whom, eighteen months
after radium and roentgen therapy for cervical carcinoma, there was
found a vesicovaginal fistula and almost complete obstruction of the
lower ends of both ureters, with perforation of the left ureter into the
peritoneal cavity, and bilateral hydroureter, hydronephrosis and
pyelonephritis. The patient succumbed and autopsy failed to reveal
any remaining carcinoma. A very similar case was reported by
Schmitz[176] in 1930. In 1934, the author[42] reported ureteral obstruc-
tions in seventeen patients following pelvic irradiation, in three of

whom the irradiation had been administered for benign lesions, and of the fourteen in whom the irradiation had been administered for carcinoma the malignant process was apparently arrested in all but
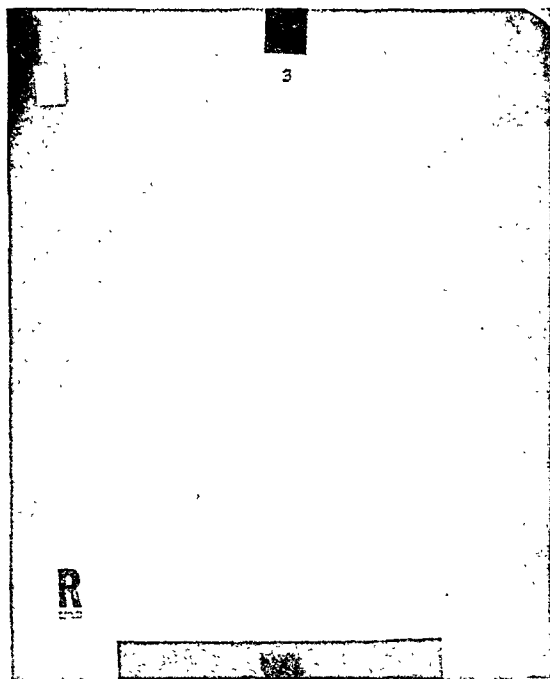
FIG. 49. Original stage II carcinoma of the cervix. Right and left pyelograms twenty months after original treatment of 2,870 mc. hr. of radium emanations, and fourteen months after a retreatment of 11,960 r of x-ray. (From Everett, H. S. *Am. J. Obst. & Gynec.*, 38: 889, 1939.)

two. Cases of ureteral obstruction following irradiation for benign lesions have also been reported by Bugbee[9] and by Kretschmer.[129] A very careful and detailed report of a study of the upper urinary tracts in cases of cervical carcinoma was reported in 1936 by Graves, Kickham, and Nathanson,[56] but although most of their patients had received irradiation therapy, some doubt is left as to the proportion showing urinary tract lesions in whom the disease had been arrested.

Recognizing the frequent incidence of other causes of ureteral obstruction in the female, and of ureteral stricture in particular, it occurred to the author that the frequency of obstruction resulting from irradiation therapy, and indeed its occurrence at all, could be proved only by a careful study of the same patients both before and after such therapy. Accordingly, forty-six patients with cervical carcinoma, in whom there seemed some possibility of cure, were

subjected to complete urologic study before any treatment was instituted. Sixteen of these showed evidence of upper tract damage, a finding which proved to be of grave prognostic significance as the treatment failed to effect a cure in any of them. Of the remaining thirty who showed no evidence of damage to the urinary tracts before treatment, in twenty-five the carcinoma was apparently cured or arrested, but only seventeen of these could be induced to return for further studies of the urinary tracts. Of these seventeen, six or 35.5 per cent showed evidence of ureteral obstruction. In a larger group of thirty-three patients including the seventeen studied before treatment and sixteen in whom such studies had not been made, but in all of whom the carcinoma apparently had been arrested, evidence of ureteral obstruction was found in sixteen patients or 48.4 per cent.[42] Similar studies have been reported by Howes and Strauss,[64] and more recently by Jaffe, Meigs, Graves and Kickham.[101] These latter authors stressed particularly the importance of the group of patients in whom evidence of ureteral obstruction was found at the time of institution of treatment. Their conclusion was that appropriate urologic treatment by ureteral dilatation or if necessary ureterostomy, nephrostomy, or even nephrectomy in such cases as were found to have one kidney infected and completely functionless, tended so to improve the general condition of such patients as to render them better able to withstand the effects of intensive irradiation therapy, thereby considerably increasing their chances for a longer and more comfortable survival.

In the author's study[42] it was found that the degree of ureteral obstruction and resulting hydroureter and hydronephrosis tended to be in direct proportion to the length of time which had elapsed since the completion of irradiation therapy. The lesson of practical significance to be learned from these studies is that ureteral obstruction does develop in a not inconsiderable proportion of patients salvaged from cervical carcinoma by irradiation therapy, and that these obstructive lesions are apt to be progressive and lead to serious results, unless appropriate means are instituted to detect them in their earlier stages and prevent their progress. Periodic urologic examinations, therefore, should be a part of the follow-up routine of all patients who have been subjected to irradiation therapy for cervical carcinoma or other genital lesions; and when evidence of beginning ureteral obstruction is encountered treatment by ureteral dilatations should be instituted.

2. *Stricture of the Ureter.* Though this disease entity is by no means confined to the female, Rathbun[171] in 1925 having reported the finding of the condition in forty-eight males and forty-four females among 739 patients examined in a single year, the recognition of the frequency of its occurence has resulted to a great extent, from the technical methods of examination made possible by the use of the Kelly "open-air" method of cystoscopy. Kelly[116] in 1902 was the first to call attention to the importance of ureteral stricture as the primary etiologic lesion in such conditions as pyonephrosis and hydronephrosis, and the possibility of relief of the diseased condition of the kidney, and the improvement or restoration of its function by proper attention to and treatment of the strictured ureter. However, in spite of this principle enunciated by Kelly, all urologists continued to believe that ureteral stricture was a rare lesion and usually of congenital origin. Such ureteral obstructions as were rarely and accidentally encountered in association with renal infections, and with ureteral or renal lithiasis were considered to be the result of these lesions, and secondary to them in importance until 1915, when Hunner[71] began his contributions to the subject, which in volume and enthusiasm have amounted to a veritable crusade. The subject is one still productive of much skeptical discussion, but the clear logic of Hunner's arguments, and still more important, the results that he has obtained by therapy directed along a line strictly in accordance with the principles that he has laid down, have served clearly to demonstrate the large element of truth in these principles, and to convince all but the most reactionary skeptics.

Hunner[88] has defined ureteral stricture as "an intrinsic disease of the ureteral wall resulting in narrowing of the lumen which leads to varying degrees of stasis in the urinary stream," and further states that "this narrowing may be congenital or acquired." He believes that the acquired type is by far the most frequent, and after careful consideration of various possible factors which might give rise to such acquired strictures, among which he mentions trauma, syphilis, the pressure of pelvic tumors, pelvic inflammations, and cervical carcinoma and its various forms of treatment, he finally concludes that the condition most frequently occurs as a chronic inflammatory process in the ureteral wall resulting from some distant focal infection elsewhere in the body. Space does not permit a full review of the various arguments in support of this theory, but they may be found in several of Hunner's publications[74,75,88] a bibliography of which will

be found appended. The most convincing of these arguments have been the frequent association of the disease with focal infections, a tendency of an exacerbation of the focal infection to produce an
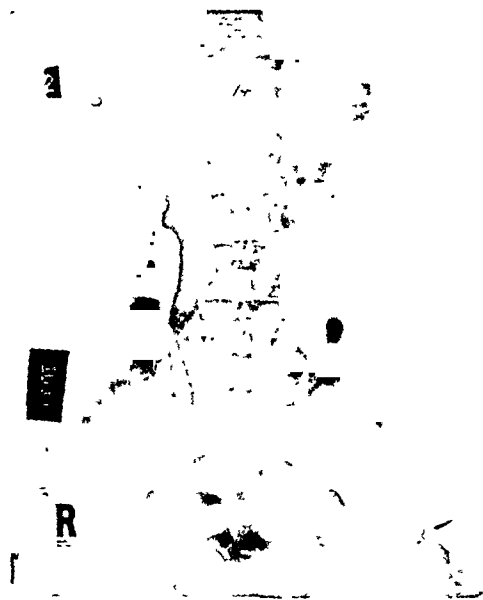
FIG. 50. Original stage III carcinoma of cervix. Right pyeloureterogram five and one-half years after first treatment with 4,500 mc. hr. of radium emanations, including gold points in the parametria. Retreatments of 1,600 mc. hr. of radium emanations and 8,640 r of x-ray had been given three and five years, respectively, after the original treatment. At the time of this examination there was no clinical evidence of carcinoma. Note the permanent needle in the right parametrium and note its distance from the ureter. (From Everett, H. S. Am. J. Obst. & Ginec., 38: 889, 1939.)

exacerbation of symptoms due to stricture, and the failure in many instances of the stricture to respond to adequate treatment by ureteral dilatations until focal infections have been eradicated.

But little has been published regarding the pathology of these lesions, due no doubt to the fact that the strictures themselves never result fatally, until superimposed urinary tract lesions of such severity as to mask the nature of the original stricture have ensued. In a study of autopsy material from eight cases by Hunner and Wharton[100]

there were only two which could be classed as possibly due to focal infection, three being of the congenital type, and three others having resulted from operative trauma or irradiation. Perhaps the most complete and valuable anatomic study of ureteral stricture was made by Schreiber.[178] A protégé of the late Edwin Beer, Schreiber on a Daniel Guggenheim Fellowship, made this study in 1926 at the Senkenberg Pathologic Institute, University of Frankfurt-am-Main. Briefly, the object of his study was to test at the autopsy table by both anatomic and pathologic data, the conception lying behind that clinical entity which has been given the name of "ureteral stricture."

After an excellent brief review of the literature, Schreiber presents with adequate illustrations the results of his study on one hundred consecutive, unpicked autopsies comprising forty-two adult males, ages twenty-two to eighty-seven years; thirty-seven adult females, aged twenty to eighty-one; and twenty-one children, ages seventh month prenatal to fifteen years.

Hunner often has expressed the verbal opinion that in a cross section of society probably considerably less than 5 per cent of the population suffers at some time the effects of ureteral stricture; but that, if we could study at postmortem that segment of society dying in a hospital, we would probably find fully 5 per cent bearing evidences of this disease. Schreiber's studies of patients dying in a city hospital and therefore representing a cross section of the under-privileged class should show a slightly higher· incidence of ureteral stricture.

Schreiber made the astonishing discovery that in his seventy-nine adults twenty-five, or about 31 per cent, presented some type of ureteral disease. In the one hundred cases (including the twenty-one children) he found twelve cases of ureteral obstruction ten due to narrowing or stenosis, and two in which he considered the hydro-ureteronephrosis as due to a scarring of the ureteral wall by surrounding inflammatory disease.

Of the ten cases of actual stenosis he considered five as of congenital origin, and, of the remaining five cases, two were due to "kinking of the ureter over anatomical structures," one over the uterine artery, and one over the vas deferens. Three were due to.local contiguous inflammatory processes invading the ureteral walls secondarily. Apparently he did not consider the possibility of any of these contiguous inflammatory processes being due primarily to a distant focus of infection. "There was not a single case in which the

lesion required the hypothesis of blood borne infection for its complete explanation."

However, Schreiber's work demonstrated that clinicians and pathologists had been neglecting the ureter as an important source of ill health. "The finding of the above 12 cases in our unselected 100 consecutive autopsies suggests that the importance and incidence of hydroureteronephrosis have been generally underestimated; and that Hunner's emphasis of this condition is justified."

The author's opinion is that such pathologic studies on relatively small groups of cases should not be accepted as disproving the theory of focal infection origin of ureteral strictures, logically derived by Hunner from a very large clinical experience. However, the persistence of hydroureter and hydronephrosis, following correction of the supposedly causative pelvic lesions, in an appreciable proportion of the cases studied by Sturgis and the author[43] leads one to believe that the influence of these lesions upon the ureter over a considerable period of time, may have resulted in stricture formation which prevented involution such as was found to occur in other similar cases. Finally then, there seems evidence to the effect, that while focal infection is very probably the etiologic factor responsible for stricture of the ureter in many cases, particularly those in which no demonstrable pathologic process has ever existed in the pelvis, such lesions may be caused by a variety of other factors.

The symptoms of ureteral stricture, as has been frequently pointed out by Hunner, are of such protean character that they may frequently lead to diagnostic confusion. Their importance as a primary etiologic factor in hydronephrosis, pyonephrosis, pyelitis, pyelonephritis, urinary calculi, "so-called" essential hematuria, and possibly renal tuberculosis, have all been repeatedly emphasized by Hunner,[74,75,76,79,81,83,86,87,92,93,94] and in such conditions the symptoms are obviously those of the resulting lesions. There is a large group of cases, however, in which no such obvious secondary effects have resulted in the urinary tract, but in which strictures of the ureter are no less demonstrable by appropriate methods of examination. Among the symptoms which have been listed by Hunner,[77,82,89] as occurring in such cases are those related to the bladder such as frequency, urgency, dysuria, incontinence and enuresis; those related to the genital organs such as dysmenorrhea, dyspareunia, a feeling of pelvic pressure or prolapse, and ovarian neuralgia; those related to the digestive tract such as anorexia, flatulence, painful defecation, and

feeling of rectal pressure; abdominal pain of less specific location, backache, and pain radiating into the thighs; and finally symptoms of a low grade toxemia such as headache and unexplained low grade fever. Many of these symptoms are those commonly complained of in functional neuroses, and when careful examination of the organs most prominently suggested by the symptoms of the individual patient have yielded negative findings, and the urine is negative and no prominent urinary symptoms have been mentioned, the patient is very apt to be assigned to this group without consideration of a possible urinary tract lesion. The complaints of many such patients are undoubtedly founded upon a functional basis, but in some, the later development of obvious more serious urinary tract lesions reveals that an organic basis for the complaints has existed, which might have been relieved had it been discovered and treated.

The diagnosis is dependent upon a careful analysis of symptoms, careful physical examination and cystoscopic study. Any of the symptoms listed above should suggest a thorough search for stricture unless some other obvious cause is discovered. In examination of the abdomen tenderness over the kidneys anteriorly or in the costovertebral angles usually can be elicited. Palpation over the ureters as they cross the pelvic brim usually will reveal tenderness with reproduction of some of the patient's most prominent symptoms. If bladder irritability has been a symptom, a desire to void is particularly apt to be produced by such palpation. On vaginal examination tenderness over the ureters in their lower broad ligament portions, as they encircle the cervix to enter the bladder wall, is apt to be even more marked than at the pelvic brim, and the reproduction of symptoms by palpation in this region is even more striking.

On cystoscopic examination if the urine is infected there is apt to be evidence of a chronic cystitis and especially a chronic trigonitis. If the urine is uninfected but strictures are present, there often will be found a small zone of reddened mucosa surrounding each ureteral orifice. The ureters should be catheterized one at a time with two or more days intervening, usually using for the first time a 7 F. catheter, upon which a fusiform bulb of bees wax, with gently sloping shoulders and maximum diameter of 10 or 11 F. has been molded about 10 cm. back of the tip. If stricture is present, the tip of the catheter occasionally and the bulb practically always will encounter resistance in passing through the stricture area. Hunner has stressed the point, however, that such resistance on introduction of the catheter does

not necessarily indicate stricture, as it may result from a fold of the
ureteral wall pushed ahead of the catheter tip or bulb, or from
temporary ureteral spasm, but that a "hang" of the bulb on with-
drawing the catheter practically always indicates stricture. It should
be emphasized here that the easy passage of a catheter with no bulb
does not eliminate the possibility of stricture. Everyone who is
familiar with the technic of this method has encountered cases in
which the first 10 cm. of a 7 F. catheter passed easily through a
stricture area, which when encountered by the bulb was found to be
so dense and so tight that the bulb was molded into a thin film of wax
extending 10 cm. or more along the catheter. Pyeloureterograms in
most instances will show some dilatation of the renal pelvis and of
the ureter above the point of stricture, but Hunner has emphasized
the fact that in some cases, particularly the earlier ones with an
active ureteritis, the renval pelvis may be smaller than normal. This
is probably best explained on the basis of reflex contraction of the
pelvic and ureteral walls, as a result of the painful nature of the
inflammatory process in the strictured area. In such cases it is obvi-
ous that an accurate diagnosis can be made only by the use of
catheters with bulbs, although if a pyeloureterogram is taken with
the catheter entirely withdrawn from the ureter, a filling defect
usually will be noted at the site of the stricture.

Treatment should consist of general measures to improve the
health of the patient, with particular attention to elimination of any
foci of infection and ureteral dilatations. The dilatations should be
accomplished by the repeated passage of catheters upon which bulbs
of increasing size have been molded. An interval of ten days to two
weeks should be allowed to elapse between treatment of the same
ureter, and the diameter of the bulb should never be increased more
than 0.6 mm. at a time, and in cases with dense strictures no more
than 0.3 mm. In those cases with strictures so dense as to mold the
wax bulbs ureteral dilating bougies may be used to advantage. In
patients who react to the treatments with an exceptional amount of
pain, or show a tendency to ureteral spasm which interferes with the
passage of the catheter and bulb, a small catheter may be passed
first, through which a few cc. of a 1 to 500 solution of nupercaine
(Ciba) may be injected and retained for fifteen minutes before
passing the bulb or bougie.

No more forceful proof of the importance of the recognition and
adequate treatment of ureteral strictures, as well as other causes of
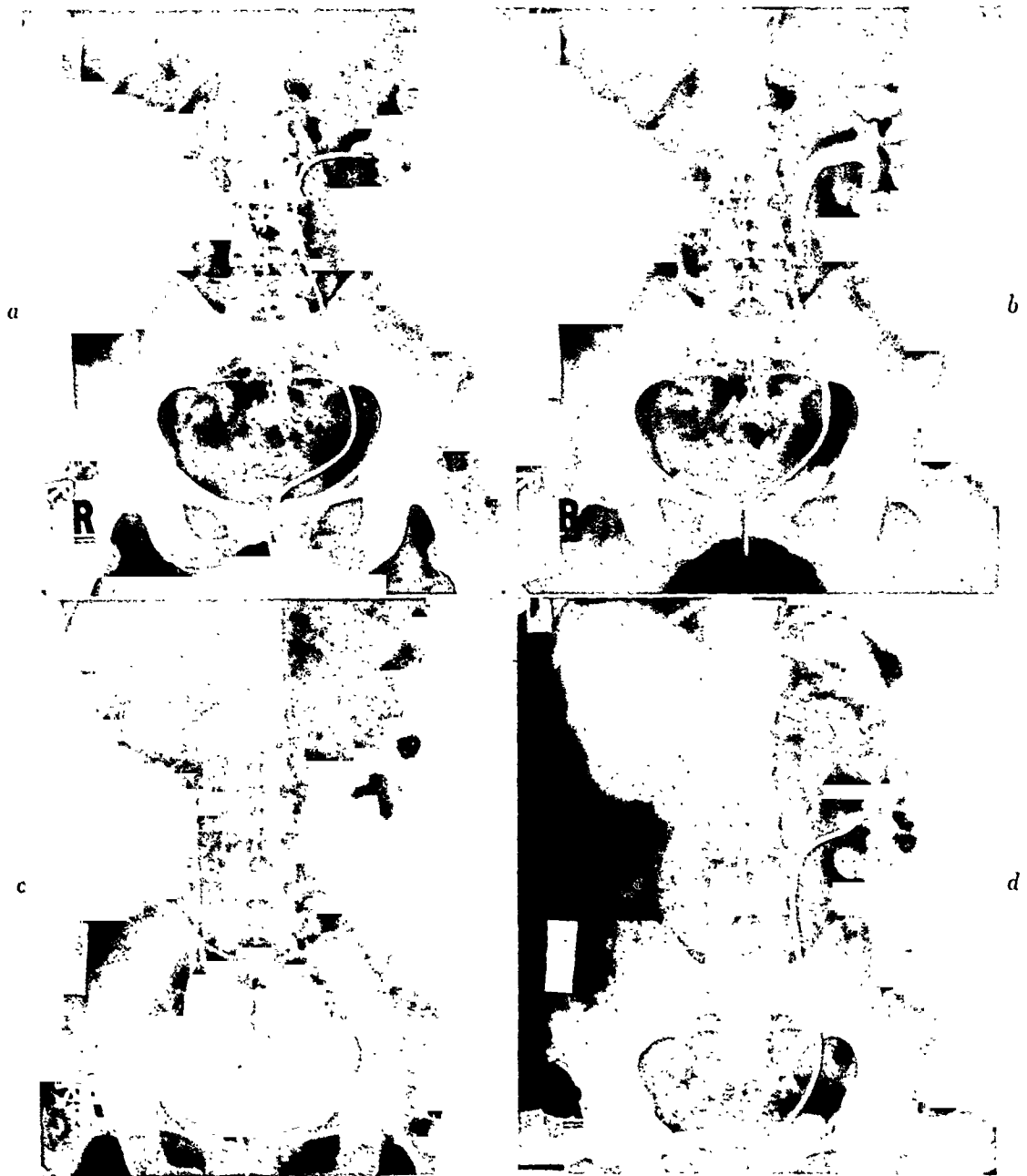
Fig. 51. Illustrating a case who had suffered from persistent pyuria and intermittent "cystitis" symptoms for twenty years before urologic examination was done. This examination showed stricture of the right ureter with functionless right kidney, intravenous pyelograms (c); multiple calculi (a) and a heavy proteus infection in the lower segment of a double left pelvis; multiple strictures in the ureter leading from this pelvis (b) and stricture of the ureter leading from the upper segment of the left pelvis (d) which was uninfected and the only portion of the patient's renal substance which was functioning normally. (From Everett, H. S. J. Urol., 36: 1, 1936.)

ureteral obstruction need be mentioned than the highly satisfactory results obtained by a systematic conscientious pursuit of this routine. These results have been most frequently emphasized by Hunner, but have also been experienced and reported from time to time by many others who have followed his teachings. In the realm of major pathologic lesions it is the general experience that chemotherapy or pelvic lavage is apt to be of little use in rendering the urine permanently sterile, so long as any obstruction to its free outflow exists. On the other hand many cases, with long standing infection and serious impairment of renal function have had the urine rendered sterile, and the function restored to normal with a complete restoration of health by the establishment of adequate drainage alone. In some cases of long standing all symptoms may be relieved and the urine become free of pus but continue to show organisms on culture. In such cases the more efficient recently discovered chemotherapeutic drugs such as mandellic acid, sulfanilamide or sulfathiazole may succeed in finally rendering the urine sterile if administered after adequate drainage has been established. In a long and otherwise excellent monograph on pyelonephritis Weis and Parker[217] have completely ignored the therapy of these conditions from the point of view of relieving urinary stasis. As a result all of their patients progressed rapidly to a fatal termination. On the other hand, Longcope[141,142] who has recognized the importance of drainage in these cases and has had his patients treated with this in mind, has reported several instances of patients first seen in an advanced stage of the disease with contracted kidneys, greatly diminished function, and hypertension, in whom the progress of the condition has been arrested and the patients maintained in a state of relatively satisfactory health over a period of several years. In cases of early renal tuberculosis Hunner[93] has been able to retard the progress of the disease so that there was little diminution in function and only slight changes in the pyelograms after two to three years. While he has not unqualifiedly recommended such treatment in cases of unilateral tuberculosis, this discovery is of tremendous importance in consideration of the therapy of this condition when there is bilateral involvement.

In patients with renal or ureteral calculi[76,81,83,87,94] it has been the practice in Hunner's clinic for a number of years to dilate thoroughly both ureters before operating for removal of the calculi. This practice has resulted in materially shortening the period of drainage from the

pyelotomy, nephrostomy or ureterostomy wounds, and more important still in a considerable reduction in the incidence of recurring stones. In cases with essential hematuria[79,92] the bleeding can usually be relieved by thorough dilatation of the ureters. Of twenty-seven such cases reported by Hunner[92] there were only three in whom operation was found necessary, although in all of them there was gross hematuria and in many the bleeding was profuse. In only one instance was it necessary to remove the kidney.

In regard to the less specific conditions, it is a common experience to encounter patients who have suffered for years from some combination of the symptoms enumerated above, and who have been subjected to various forms of therapy, in many instances including one or more major operations, without relief, who are promptly relieved and restored to health upon the discovery and adequate treatment of ureteral strictures. It seems, however, that a word of warning is appropriate here, namely that it is unwise to ignore the existence of such conditions as functional neuroses. There are undoubtedly certain individuals who "enjoy poor health" and who bask in the warmth of the ministrations of physicians and the sympathies of their families and friends. To avoid catering to the whims of this class, even though ureteral strictures may be demonstrated, if the renal function is normal and the urine is uninfected and an adequate series of ureteral dilatations fail to achieve symptomatic relief, the treatment should not be persisted in further, but the aid of psychiatric consultation and therapy should be sought.

3. *The Urinary Tract in Pregnancy.* Anatomic, physiologic and pathologic changes in the urinary tract occurring during pregnancy and the puerperium have been the subject of much interesting investigation, as well as some not too sound speculation, since 1843 when Cruveilhier[24] first described dilatation of the ureters as a frequent accompaniment of the gravid state. Such studies were of necessity limited to anatomic observations made at autopsy or during operations until the perfection of modern urologic, roentgenologic and bacteriologic technic made possible careful detailed studies upon living subjects. The advent of such technic, however, has given a tremendous impetus to such studies, and a wealth of data has accumulated which is not only of great scientific interest but also of invaluable practical importance. The results of much sound and valuable investigative work have been reported by Traut and his associates from the New York Hospital, and Hundley and his asso-

ciates from the University of Maryland, to mention specifically only
two groups among many who have contributed much. In a recent
brief but comprehensive review Traut and Kuder,[36] after eliminating
many reports of a confirmatory nature, still have appended a bibli-
ography consisting of 330 references, and the reader desiring such a
review is referred to their report. Although this is one of the most
important phases of urology peculiar to the female, our remarks
must be confined to a summary of the present status of our knowl-
edge. For this purpose the material which has emanated from the
clinics of the two groups mentioned above will be extensively drawn
upon, and the acknowledgement of this fact is hereby made.

a. *Anatomic and Physiologic Considerations.* The most widely
recognized change that occurs in the urinary tract during pregnancy
is a dilatation of the ureters and renal pelves. This was first observed
in the course of anatomic studies, but more recently has been repeat-
edly demonstrated by urographic studies. This change is observed in
over 80 per cent of all pregnant women (Traut) and has been demon-
strated among others by Baird,[1] Kretschmer, Heaney, and Ockuly,[132]
and Hundley and his associates.[65] The dilatation is usually more
marked on the right side, and several causative factors for its produc-
tion have been postulated. Among these factors should be mentioned
first pressure from the pregnant uterus. Though such pressure is
probably not the only factor concerned, there is much evidence to the
effect that it is a very important if not the chief one. Among such
evidence may be cited the fact that the ureters are rarely dilated
below the pelvic brim, and that dilatation is rarely observed before
the sixteenth week of pregnancy, when the uterus rises above the
level of the pelvic brim. Similar dilatations have been observed in
patients suffering from large pelvic tumors, either uterine fibroids or
ovarian cysts. Hundley and his associates[65] studied a small group of
such cases, which included uterine fibroids only, and came to the
conclusion that a softening of the ureter which was observed in
pregnancy and attributed to an hormonal effect, was probably an
essential prerequisite to compression by the softer and less rigid
pregnant uterus. In the series with tumors studied by Kretschmer
and Kanter,[3] however, the incidence of ureteral dilatation in patients
with large ovarian cysts was greater than in those with fibroids. The
fact that the right tract is dilated more frequently and usually to a
greater extent than the left, can be explained only on the basis of
pressure. Any other effect, such as an hormonal one, should be dis-

tributed equally to the two sides, but the protective covering of the left ureter by the sigmoid, as well as the usual tendency toward dextrorotation of the uterus, renders the right ureter decidedly more subject to pressure as it crosses the pelvic brim. Lee and Mengert[137] found no diminution in the dilatation of the ureters and pelves after drainage through indwelling catheters for twenty-four hours, but Hundley and his associates[65] who repeated the experiments, leaving the catheters in place for forty-eight or seventy-two hours, found definite diminution in the size of the dilated tracts after these longer periods of drainage. Mengert[153] failed to find ureteral and pelvic dilatation in eight different species of four-footed animals, in which posture obviously would obviate pressure of the uterus upon the ureters.

Hofbauer,[62,63] and Hundley and his associates[65] observed an edema of the ureteral wall and an hypertrophy of the musculature, particularly that found in the periureteral sheath of Waldeyer encircling the juxtavesical portion of the ureter. Hofbauer believed that this hypertrophy of the sheath of Waldeyer was the chief causative factor of the ureteral dilatation; but such an explanation would require that the dilatation should be approximately equal on the two sides, and that it should extend into the pelvic portion of the ureter. Hundley has observed similar histologic changes in a woman dying of a ruptured ectopic pregnancy at the seventh week of gestation, and in a man dying of a teratoma of the testis containing much chorionic tissue, in neither of whom were the ureters dilated. Hundley and his associates have postulated the greatly increased amount of estrogenic hormone which is elaborated during pregnancy as responsible for these histologic changes, but the same authors in a small series of animal experiments were not able to reproduce the changes by administration of considerable quantities of this hormone. Brack and Langworthy[7] have demonstrated that the estrogenic hormone increases the tonicity of vesical muscle.

Traut and McLane,[207] and Traut, McLane, and Kuder[208] have conclusively demonstrated by the use of an apparatus devised by Trattner and called an hydrophorograph, that there is a loss of muscular tone and diminution of peristaltic activity in the ureter, beginning in the third month of pregnancy and increasing progressively until the two final months, when there is evidence of some regression of these hitherto progressive alterations. Coincident with the return of muscular irritability during the two final months of

a   b
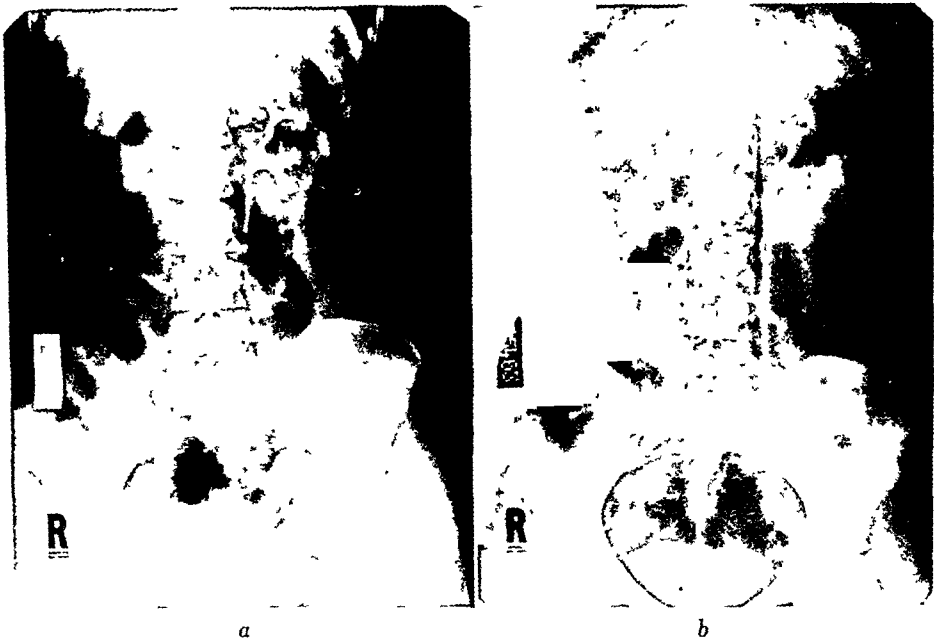
FIG. 52. The patient illustrated here, white, aged thirty-one, had suffered from severe dysmenorrhea since the onset of menstruation. The cervix had been dilated on two occasions and eight years before the appendix was removed, the uterus suspended, and the presacral plexus resected. None of these procedures have given relief from the dysmenorrhea, and for the past eight years she has suffered from attacks of severe pain in the right lower quadrant usually lasting for about ten days and occurring at intervals of two weeks to three months. For the past four years these attacks have been accompanied by severe nausea and vomiting. Her only pregnancy eight years ago was terminated at the third month because of pernicious vomiting. She has undergone several x-ray examinations of the gastrointestinal tract with negative findings. There have been no urinary symptoms and examination of the urine has never revealed any abnormality. Examination of the abdomen, however, showed marked tenderness of the ureters as they crossed the pelvic brim, and on vaginal examination tenderness was even more marked in the lower broad ligaments. The genital organs were normal to palpation. At cystoscopic examination February 5, 1941, the left ureter was catheterized with a No. 7 renal catheter, but on the right side a similar catheter could not be passed more than 3 cm. above the orifice. The left kidney excreted 35 per cent phenolsulfonphthalein in a half hour, but no dye was recovered from the right kidney through the bladder. The retrograde pyeloureterogram (a) of the left side would probably ordinarily be interpreted as normal, but careful inspection shows dilatation of the usually narrow portions of the ureter, so that it is about the same caliber throughout from the broad ligament region upward. Intravenous pyelograms (b) showed no visualization of the right pelvis until seventy minutes after injection of the dye. There is considerable retention of the dye in the left pelvis and ureter even after this interval and the last 3 cm. of ureter above the bladder are markedly narrowed.

gestation, these authors have also observed some diminution in the degree of dilatation of the pelves and ureters in the same subjects. This last observation has not been recorded by other investigators. The authors believe that "This diminished peristaltic activity of the ureters—cannot be explained on the basis of dilatation. On the contrary, dilatation of the ureters during pregnancy is probably in great part dependent upon the atony of the ureters." Again, if this were true, it may be reasoned that the dilatation should be more nearly equal on the two sides. Following delivery they have found that atony is again marked until the third week, after which motility returns rapidly to normal levels, which are usually attained during the sixth or seventh week postpartum. It also has been found that about the same length of time usually is required for complete disappearance of all dilatation of the upper tracts. The authors postulate a chemical or hormonal basis for the production of this atony, which they consider as similar to that occurring in the uterus under the same circumstances. They make no such statement, but it is generally considered that progesterone is responsible for uterine atony, and some recent work of Langworthy and Brack[134] has tended to show that the same substance is responsible for increase in capacity and decrease in tone of the bladders of rabbits during pregnancy. Muellner[159] in a recent cystometric study has shown that in the human the capacity of the bladder is increased and its tone diminished during pregnancy and the puerperium. These changes were also found to begin at the third month and increase progressively and to follow about the same time relationships as the similar changes in the ureter, except that no regression was noted in the two last months of gestation.

b. *Bacteriologic Considerations.*   It has been frequently stated that pathogenic micro-organisms can be recovered from the bladder urine of a large proportion of normal pregnant women, and that the normal kidney can excrete micro-organisms with no impairment to itself or the other urinary organs. Recent carefully conducted bacteriologic studies, however, have tended to disprove at least the first part of this statement. Eighty to 90 per cent of the urinary tract inflammations occurring during pregnancy are caused by members of the coliform group of micro-organisms. McLane and Traut[150] recovered such organisms from the bladder urine in only 6.08 per cent of their examinations, representing 115 observations made on a group of thirty women, and from the kidney urine only once or 0.86

per cent. Hundley and his associates[66] in a similar study of fifty women recovered coliform organisms from the upper tract in 6 per cent and from the bladder in 9 per cent.

The route by which the offending organisms reach the upper urinary tracts in pyelitis and pyelonephritis, occurring in association with pregnancy and otherwise, has been the subject of much speculation and investigation. Without going into detailed discussion it may be said that three routes have been considered, namely: (1) from the bladder by reflux into the ureter and antiperistalsis of the ureter; (2) from the bladder, urethra, genital organs, or intestines through the blood stream; and (3) from the same sources through lymphatic conduction. While it is conceivable that infection through anyone of these routes may occur in certain instances, there seems to be least evidence in support of the first and most in support of the third as the usual route of invasion.

c. *Pyelitis of Pregnancy: Etiology.* With pelvic and ureteral dilatation and urinary stasis occurring in a large proportion of pregnant women, and the recovery of coliform organisms from the upper urinary tract at least occasionally in women showing no clinical evidence of an actual inflammatory reaction, some additional etiologic factors are necessary to explain the actual production of an inflammatory reaction in those patients in whom it occurs. The incidence as reported from different clinics varies widely as may be seen from the following table taken from Traut and Kuder with additions:

	Per Cent
Kiel Frauenklinik (Freudenberg)	1 8
Boston Lying-In Hospital (Crabtree)	2 1
New York Lying-In Hospital (Traut)	2 2
London, Guys Hospital (Gibberd)	1–2 0
London, University College Hospital (Dodds)	1 1
Glasgow Royal Infirmary (Baird)	14 to 16 0
New York (Pugh)	10 0
San Francisco (Emge)	7 0
Griefswald (Phillipp)	3 5
Montreal (Seng) .. .	3 0
Vienna (Latzko) (Lepoutre)	7 0
Amsterdam (Van Rooy)	0 8
University of Maryland (Hundley)	3 1
Johns Hopkins Hospital (1939 and 1940 Hellman)	0 5

Among the contributing factors which render the pregnant woman more susceptible to inflammatory disease of the urinary tract may be mentioned constipation with intestinal stasis, previous

inflammations of the urinary tract, particularly those which may have occurred in childhood or previous pregnancies, lesions of or involving the urinary tract which may tend to intensify or increase the stasis ordinarily encountered in pregnancy; and finally, with particular reference to those cases occurring during the puerperium, traumas occurring during delivery especially those which tend to interfere with the normal emptying of the bladder and necessitate repeated catheterization. The first of these factors, intestinal stasis, has been particularly emphasized by Traut,[204] who believes in the lymphogenous route of infection and that such stasis may result in larger quantities of coliform organisms reaching the urinary tract. Obstructive lesions of the urinary tract which tend to intensify the stasis, particularly ureteral stricture have been emphasized by Hunner.[84] As such lesions are apt to have been present and of primary etiologic importance in the production of any previous inflammatory disease of the urinary tract, which may be considered as contributing to an attack of pyelitis of pregnancy, their importance cannot be overemphasized. In a woman known to have suffered previously from a urinary tract infection who is contemplating marriage and pregnancy, thorough treatment of any discoverable obstructive lesions of the ureters may be of the greatest importance as a prophylactic measure. The care of patients suffering from urinary retention following operation or delivery has been discussed in a previous section.

Pathology. Traut and Kuder[206] after a careful consideration of the various terms used to designate the disease process under consideration, chose "pyeloureteritis" as the term most accurately descriptive of the process occurring in most cases. They believe that in most instances the inflammatory process is confined to the tissues of the renal pelvis and ureter, and that the term pyelonephritis should be limited to those severe cases in whom there is evidence of retention of nonprotein-nitrogen in the blood. This position does not seem entirely tenable. In the first place if the infection is unilateral, extensive parenchymal involvement and impairment of function may occur without nitrogenous retention because of the continuing normal excretory activity of the opposite kidney. In the second place the study of autopsy material from patients giving a history of "pyelitis" in the past, but dying subsequently of other causes, reveals that the kidney or kidneys practically always show evidence of some parenchymal involvement.

Symptoms and Diagnosis. Pyelitis or pyeloureteritis of pregnancy is usually thought of as an acute illness in which the patient suffers from chills with a high intermittent fever. During such
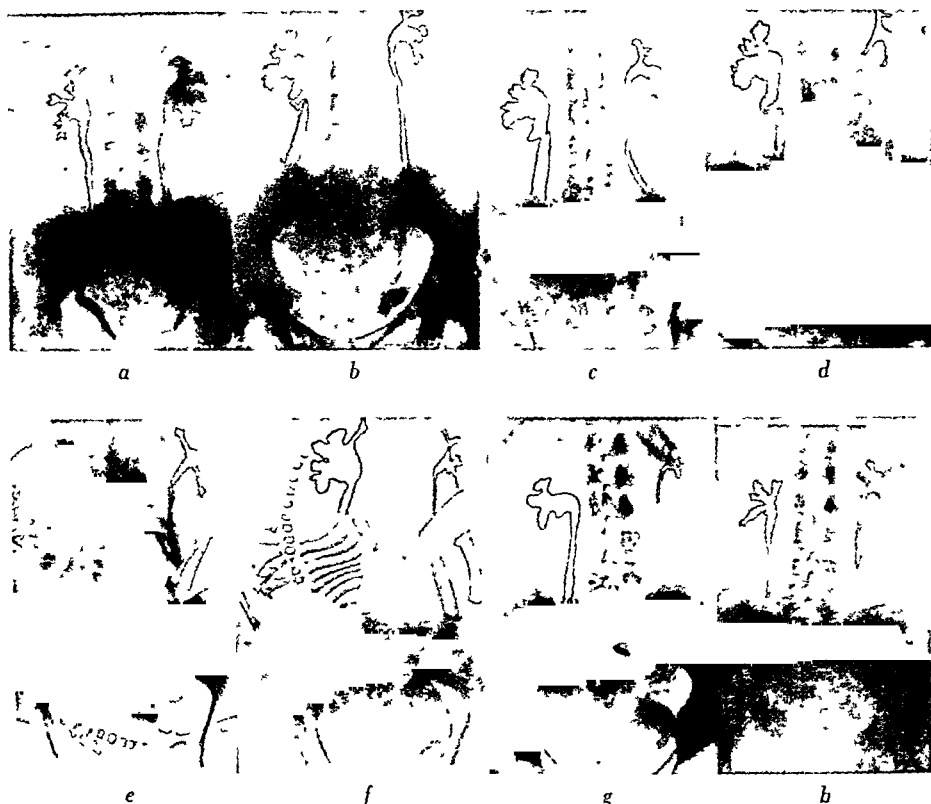
FIG. 53. Intravenous urograms (outlined for better reproduction) at various weeks of pregnancy and the puerperium: (a) 15 weeks, (b) 18 weeks, (c) 22 weeks, (d) 26 weeks, (e) 34 weeks, (f) 39 weeks, (g) 1 week postpartum, and (h) 6 weeks postpartum. All urograms except those shown in (a) are from the same patient. (From Hundley, J. M. et al. *Am. J. Obst. & Gynec.*, 30: 625, 1935.)

episodes the patient usually experiences general malaise with anorexia and often there is nausea and vomiting. Pain and tenderness are present both anteriorly and posteriorly over the kidney and along the course of the ureter, and frequent micturition with pain results from the cystitis which nearly always is also present. The condition is most frequently unilateral, the right tract being the one most often involved, though bilateral involvement and left-sided unilateral involvement occur not infrequently. Examination of the urine shows much pus with clumping of the cells and culture yields a heavy growth of organisms usually of the coliform type. During such acute

episodes the diagnosis usually should be quite evident, though the presence of digestive symptoms associated with right-sided abdominal pain and tenderness may at times suggest the possibility of acute appendicitis. The urine examination in such cases should serve to settle the question except in the rare instance of an acute appendicitis being accompanied by an acute pyelitis.

Traut and Kuder[206] have pointed out that emphasis has been placed largely upon such acute episodes, with neglect of chronic upper tract infections until their persistence eventually leads to such acute febrile illnesses. In order to detect such chronic phases of the disease, and thereby be in a better position to prevent the more serious acute episodes, serious attention should be given during the prenatal care of patients to any history suggesting a previous urinary tract infection, to the development of any symptoms suggesting a cystitis, and to the presence in the urine of any unusual amount of pus, particularly if there should be a tendency to clumping of the pus cells.

Prophylaxis and Treatment. Traut, Bayer, and McLane,[205] have given an excellent formula for the handling of obstetric patients during their antepartum care, in such a way as to reduce as far as possible the incidence of acute febrile "pyeloureteritis." They divide the patients into two groups; those who give no history of previous urinary tract infection, and those who do give such a history. The patients in the former group are questioned at each antepartum visit concerning such symptoms as frequency, dysuria and pain in the kidney region. If any of these symptoms are complained of, or if albumin is found in the urine without any other evidence of toxemia, a sterile catheterized specimen of urine is obtained for microscopic study and culture. If the culture proves to be positive for coliform organisms 0.3 Gm. of sulfanilamide are administered five times a day for five days and the fluid intake is limited to 1,500 cc. daily. As is always the case when administering sulfanilamide, an equal amount of sodium bicarbonate should be given. The patient returns after a week when the urine culture is repeated. If the second culture is positive, a complete urologic study is made including cystoscopy, ureteral catheterization with culture of the ureteral urines, differential kidney function tests and pyelograms. Even if the second culture is negative, the course of sulfanilamide is repeated after one week's rest, until a series of three negative urine cultures are obtained. The urine is then cultured once a month until delivery and

THE JOHNS HOPKINS HOSPITAL

Ward_____　　　　　　　　　　　　　　Unit History No.__*127705*_____

Name__*B ······, Mrs. E·····*　　(24 yrs.)　　　　Service__*Obst.*_____

Page No. *1*　　　*October*

Year *1939* Date	*9*	*10*	*11*	*12*	*13*	*14*		
Day of Illness Operation Delivery								

Stools	0	2	2	2 0	0 2	2 0	0
Fluid Intake	3000 cc	3600 cc	2000 cc	1800 cc	2850 cc.	3900 cc.	4100 cc.
Urine	1200 cc	450 cc.	250 cc	250 cc	575 cc.	1000 cc	1500 cc.
Weight				Through Rt. Kid Catheter		2010 cc.	425 cc
Height							
Medication	sulfanilamide 3.6 gms	sulfanilamide 6.0 gms.	sulfanilamide 6.0 gms.	sulfanilamide 1.2 gms.			
Temperature							
Pulse							

FIG. 54. E. B. white, aged twenty-four, para 5. Postpartum pyelitis; temperature chart. The patient was delivered at home. Symptoms of pyelitis began on the sixth day after delivery and became severe on the sixteenth day when she was admitted. Sulfanilamide therapy at first seemed effective but a short afebrile period was followed by fever which reached 107°F. Sulfanilamide was then stopped in the belief that the fever may have resulted from the drug. On the following day an inlying catheter was inserted to the right kidney. Thick purulent urine drained through the catheter which was left in place and irrigated for six days. Following insertion of the catheter, the fever quickly subsided and sulfanilamide therapy was resumed. Two weeks after the acute symptoms had subsided complete urologic investigation was made with results shown in Figure 55.

the above treatment repeated should a positive culture again be obtained.

This routine would seem adequate, and in the hands of its authors has contributed toward reducing the incidence of febrile attacks of pyelitis in their clinic by 50 per cent. With such small doses of sulfanilamide the authors reported an incidence of unfavorable reactions of only 1 per cent. Nevertheless, the most recent trend is to substitute sulfathizole which has proved to be equally effective and much less apt to produce toxic reactions or unpleasant symptoms.

In the group from whom a history of previous urinary infection is elicited every effort is made to obtain accurate data concerning this infection and urine is cultured at the first visit. If the culture is negative it is repeated at each antepartum visit, during the puerperium, and twice after discharge. If the culture is positive, a complete urologic study is carried out at once and the patient is placed on ambulatory sulfanilamide therapy as outlined for the former group. She is seen at biweekly intervals until the completion of her pregnancy, unless an acute episode intervenes.

These regimes may be said to be excellent from the obstetrical point of view. From the urologic point of view, however, it is noteworthy that no mention is made of urologic treatment, other than chemotherapy, in those patients in whom the urologic studies reveal abnormalities such as obstructive lesions in the ureters. It is generally conceded that the presence of such lesions greatly reduces the effectiveness of even such efficient chemotherapeutic agents as sulfanilamide and sulfathiazole. The correction of such lesions when found by adequate dilatations of the ureter, therefore, can greatly enhance the value and effectiveness of chemotherapeutic measures. Such treatments are often somewhat difficult to carry out in the later months of pregnancy, and provided the patient is responding adequately to medicinal therapy they may be deferred until after the puerperium. If, however, chronic inactive infection in association with a lesion of this type should be discovered in the earlier months of gestation, thorough urologic treatment at this time affords additional protection against acute febrile attacks during the later months. During the past two years similar chemotherapeutic measures as those suggested by Traut, Bayer, and McLane have been carried out on the Obstetric Service at the Johns Hopkins Hospital, but in addition active urologic treatment under the direction of the author also has been resorted to when indicated. The

incidence of acute febrile attacks on this service during this time
has been only 0.5 per cent.

The rôle of the urologist in the prophylaxis and treatment of
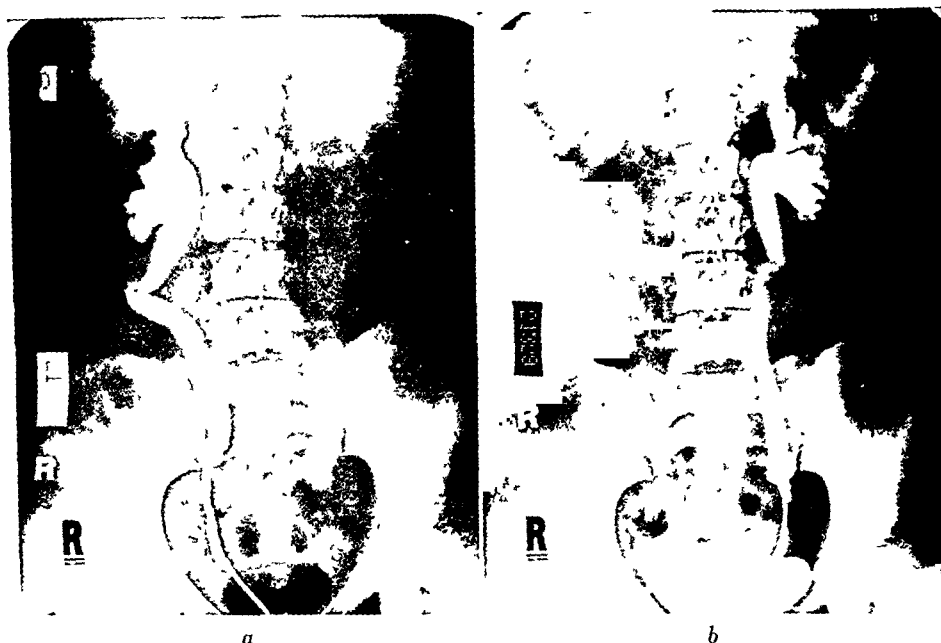
FIG. 55. Postpartum pyelitis: (a) right, and (b) left pyeloureterograms. Note the marked
dilatation of the pelves and of the ureters above the pelvic brim and the narrowing of
their broad ligament portions. Wax bulbs hung firmly in the lower ureters on both
sides. There was a calculus 15 mm. in diameter in the right ureter at the point of
angulation. It appears in the plate (a) as an area of decreased opacity; in plate (b)
made two days later it has descended into the pelvic ureter. A week later the calculus
was removed by ureterotomy and the lower end of the right ureter was thoroughly
dilated. Seventeen days later tubal sterilization was done, and the patient has been
followed with repeated ureteral dilatations. The urine has become sterile and the renal
function has returned to normal.

pyelitis of pregnancy antedates conception and continues long after
delivery and the puerperium. Indeed it may be said to begin often
in the childhood of the patient. Doubtless many of the previous
urinary infections referred to by Traut, Bayer, and McLane occurred
in childhood. In a study of thirty patients who had experienced one
or more acute attacks of pyelitis during childhood, Wharton, Gray,
and Guild[218] found urologic abnormalities in 57 per cent. Urine
cultures were positive in 50 per cent, although an average of 9.6
years had elapsed since the last attack of acute pyelitis. In only two
of the thirty patients, however, was there any persistence of symp-
toms, a fact which probably had led the patients in some instances

to discontinue urologic observation and treatment before every effort had been made to restore the urinary tract to a condition as nearly normal as possible.

In the case of a young girl or woman who has suffered a urinary infection, and in whom there is possibility of future pregnancy, frequent urologic observation and treatment, with particular attention to elimination of obstructive lesions, should be continued until the urine has become and remained sterile for at least two years before a pregnancy should be contemplated with equanimity. In those patients in whom the urine cultures remain positive in spite of all forms of treatment, and particularly if there is evidence of reduction in renal function, the condition should be considered as chronic pyelonephritis and the patients advised positively against pregnancy.

In the treatment of the acute attacks sulfanilamide and sulfathiazole have proved most effective. It was formerly considered that it was impossible to sterilize the urine in these cases until after the termination of pregnancy. With the use of sulfanilamide, however, Traut, Bayer and McLane[205] achieved this result in 55 per cent of their patients, and reduced the average duration of the febrile phase from 10.4 days to 5.4 days. They used the drug in large doses, 6 to 8 Gm. daily for the first two days, and sufficient thereafter to maintain a blood concentration of 8 to 10 mg. per cent and a urine concentration of more than 100 mg. per cent. Recent reports (Alyea and Roberts,[3] Cook[22]) although not dealing with pyelitis of pregnancy, seem to indicate that equally satisfactory results might be obtained with smaller doses. If the condition is unilateral and chemotherapy fails to relieve it, sufficient drainage may often be obtained by the introduction of an inlying ureteral catheter for a few days, during which time the chemotherapeutic drug may act more effectively. If the ureter is strictured and the acute phase can be relieved either by drugs alone, or by drugs administered while an inlying catheter is in place, subsequent dilatations of the stricture will materially reduce the probability of recurrence of acute symptoms.

If the acute symptoms fail to respond to any of the above forms of treatment, and particularly if evidences of retention of nitrogenous material in the blood begin to appear, the pregnancy should be terminated without delay. Bilateral involvement and secondary invasion of the urinary tracts by organisms other than the coliform group greatly increase the probability of the necessity of such an

eventuality. Nephrostomy as a procedure which may prolong the pregnancy sufficiently to permit the delivery of a viable child, and at the same time relieve the condition of the mother, has been recommended (Phaneuf and Graves,[169] Graves and Buddington[57]). Although we have had no experience with this method, our experience with nephrostomy in gravely ill patients with ureteral obstruction from other causes has been sufficiently satisfactory to make us feel that it is worthy of serious consideration in this group also.

VIII. CONCLUSION

An effort has been made to set forth herein most of the conditions of the urinary tract which are peculiar to the female, and to point out the important and close relationship that exists between many of these conditions and the specialities of gynecology and obstetrics. It is our firm conviction that a modern Woman's Clinic cannot be conducted to the best advantage unless there is constantly available the services of a competent urologist. In our own clinic from its beginning the urologic work has been handled by the members of our own staff, all of whom are thoroughly trained in the Kelly method of cystoscopy and in the general principles and technic of urologic surgery. We are convinced that the Kelly technic of cystoscopy for women affords many advantages over the technic available to those only familiar with the Nitze type of instrument. We are further convinced that a more complete and composite picture of the anatomic, physiologic and pathologic entities occurring in the genito-urinary systems of women can be obtained by gynecologists and obstetricians who are trained to conduct their own urologic investigations and treatments, than is available to those who find themselves under the necessity of calling to their assistance urologists, whose primary interest often centers upon the fields of prostatic and renal surgery.

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